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CONTENTS

Alternaria themes and variations (287-304). Species on Caryophyllaceae **Emory G. Simmons** 1

Notes on Hyphomycetes. LXXXVI. Some additional *Haplotrichum* species, with supplementary comments on, and a key to, the genus **E. Christopher Partridge, William A. Baker, & Gareth Morgan-Jones** 41

Notes on Hyphomycetes LXXXVII. *Rhexoacrodictys,* a new segregate to accommodate four species previously classified in *Acrodictys* **William A. Baker, E. Christopher Partridge, & Gareth Morgan-Jones** 95

Halosarpheia heteroguttulata: anamorph and report from the Northern Hemisphere **J. L. Anderson & C. S. Shearer** 115

A new variety of *Nitschkia parasitans* hyperparasitic on *Nectria cinnabarina* from American beech **Vladimir Vujanovic** 121

Speiropsis rogergoosensis sp. nov. from India **T. S. Keshava Prasad & D. J. Bhat** 127

New conidial fungi from Andaman Islands, India **Maria D'Souza, Sanjay K. Singh, & D. J. Bhat** 133

Scoleciasis atkinsonii, an earlier name for *Phaeophleospora hebes,* and a note on G. H. Cunningham's epithets *here* and *pseudopanax* **S. R. Pennycook & E. H. C. McKenzie** 145

Two new species of Ustilaginomycetes and a species new to China **Lin Guo** 147

Phylogeny of agarics: partial systematics solutions for bryophilous omphalinoid agarics outside of the Agaricales (euagarics) **Scott A. Redhead, Jean-Marc Moncalvo, Rytas Vilgalys, & François Lutzoni** 151

Favolaschia calocera, a tropical species collected in Italy **Alfredo Vizzini & Mirca Zotti** 169

Mycodiversity studies in selected ecosystems of Greece: I. Macrofungi from the southernmost *Fagus* forest in the Balkans (Oxya Mountain, central Greece) **Dimitrios M. Dimou, Georgios I. Zervakis, & Elias Polemis** 177

Distribution of *Battarea phalloides* in Mexico **Martín Esqueda, Teófilo Herrera, Evangelina Pérez-Silva, Armando Aparicio, & Gabriel Moreno** 207

Annotated check list of wood-rotting Basidiomycetes of Hawai'i **Robert L. Gilbertson, Donna M. Bigelow, Don E. Hemmes, & Dennis E. Desjardin** 215

Taxonomy of the *Russula xerampelina* group. Part 2. Taxonomic and nomenclatural study of *Russula xerampelina* and *R. erythropoda* **Slavomír Adamčík** 241

New species of *Oudemansiella* and *Pouzarella* (Basidiomycetes: Agaricales) from Puerto Rico **Timothy J. Baroni & Beatriz Ortiz** 269

[Content continues inside front cover]

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For subscription details, availability in microform, and availability of articles as photocopies or tear sheets, see back cover.

[Contents continued from front cover]

First record of *Neolentinus schaefferi* in the Americas
Bernardo E. Lechner & Jorge E. Wright 281

New records of the Corticiaceae from mainland China **Sheng-Hua Wu** 289

Cladistic analysis of the Polyporaceae using morphological characters
Seon-Young Kim & Hack Sung Jung 295

Phylogenetic evaluation of *Polyporus* s. str. based on molecular sequences
Kwan Soo Ko & Hack Sung Jung 315

New records of *Ramariopsis* from Mexico
Ricardo García-Sandoval, Margarita Villegas, & Joaquín Cifuentes 323

Myxomycetes of the State of Bahia, Brazil: historical review and current situation
Artistóteles Góes-Neto & Laise de Holanda Cavalcanti 335

Biosystematics of the myxomycete *Arcyria cinerea*
Jim Clark, Martin Schnittler, & Steven L. Stephenson 343

Notes on two violet species belonging to Physarales (Myxomycetes)
A. Castillo, G. Moreno, C. Illana, & H. Singer 347

Two additional species of *Verrucisporota*, one with a *Mycosphaerella* teleomorph, from Australia **Vyrna Beilharz & Ian Pascoe** 357

A new species of *Ascochyta* from leaf spots *on Peperomia* spp. in Brazil
José Mauricío Pereira & Robert Weingart Barreto 367

Teichosporaceae, another family in the Pleosporales **Margaret E. Barr** 373

Phytophthora cinnamomi var. *robiniae* var. nova on black locust in Jiangsu province of China **H. H. Ho** 391

Three new *Pseudocercospora* species, one with a *Mycosphaerella* teleomorph, from *Kennedia* in Australia **Vyrna Beilharz, I. G. Pascoe, & D. G. Parbery** 397

Notes on two corticolous lichens from South America
María Inés Messuti & Lidia I. Ferraro 409

A new *Dictyosporium* species from *Musa acuminata* in Thailand
W. Photita, P. Lumyong, E. H. C. McKenzie, K. D. Hyde, & S. Lumyong 415

New combinations and records of lichenized-fungi from southern South America
Alan M. Fryday 421

New species of the lichen genus *Coccotrema* from southern South America
María Inés Messuti 429

Amandinea cacuminum: a new combination (Physciaceae, lichenized Ascomycetes)
H. Mayrhofer & J. W. Sheard 437

Pseudopaulia tessellata, a new genus and species in the Lichinaceae (lichenized Ascomycotina) from Socotra, Yemen **Matthias Schultz** 443

A new name for *Sporidesmium fuscum* Gulis & Marvanová
Ludmila Marvanová & Vladislav Gulis 451

Trechispora antipus sp. nov., une seconde espèce bisporique du genre *Trechispora* (Basidiomycota, Stereales) **Gérard Trichies & Ben Schultheis** 453

Phacellium stephanandricola sp. nov. on *Stephanandra*
Hyeon-Dong Shin & Jeong-Dong Kim 459

The Hypocreaceae of China IV. Some new records of the genus *Hypocrea* from China
Pei-Gui Liu, Xiang-Hua Wang, Fu-Qiang Yu, & Huan-Di Zheng 463

[Content continues inside back cover]

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TABLE OF CONTENTS, VOLUME EIGHTY-TWO

Alternaria themes and variations (287-304). Species on Caryophyllaceae **Emory G. Simmons** 1

Notes on Hyphomycetes. LXXXVI. Some additional *Haplotrichum* species, with supplementary comments on, and a key to, the genus **E. Christopher Partridge, William A. Baker, & Gareth Morgan-Jones** 41

Notes on Hyphomycetes LXXXVII. *Rhexoacrodictys,* a new segregate to accommodate four species previously classified in *Acrodictys* **William A. Baker, E. Christopher Partridge, & Gareth Morgan-Jones** 95

Halosarpheia heteroguttulata: anamorph and report from the Northern Hemisphere **J. L. Anderson & C. A. Shearer** 115

A new variety of *Nitschkia parasitans* hyperparasitic on *Nectria cinnabarina* from American beech **Vladimir Vujanovic** 121

Speiropsis rogergoosensis sp. nov. from India **T. S. Keshava Prasad & D. J. Bhat** 127

New conidial fungi from Andaman Islands, India **Maria D'Souza, Sanjay K. Singh, & D. J. Bhat** 133

Scoleciasis atkinsonii, an earlier name for *Phaeophleospora hebes,* and a note on G. H. Cunningham's epithets *here* and *pseudopanax* **S. R. Pennycook & E. H. C. McKenzie** 145

Two new species of Ustilaginomycetes and a species new to China **Lin Guo** 147

Phylogeny of agarics: partial systematics solutions for bryophilous omphalinoid agarics outside of the Agaricales (euagarics) **Scott A. Redhead, Jean-Marc Moncalvo, Rytas Vilgalys, & François Lutzoni** 151

Favolaschia calocera, a tropical species collected in Italy **Alfredo Vizzini & Mirca Zotti** 169

Mycodiversity studies in selected ecosystems of Greece: I. Macrofungi from the southernmost *Fagus* forest in the Balkans (Oxya Mountain, central Greece) **Dimitrios M. Dimou, Georgios I. Zervakis, & Elias Polemis** 177

Distribution of *Battarea phalloides* in Mexico **Martín Esqueda, Teófilo Herrera, Evangelina Pérez-Silva, Armando Aparicio, & Gabriel Moreno** 207

Annotated check list of wood-rotting Basidiomycetes of Hawai'i **Robert L. Gilbertson, Donna M. Bigelow, Don E. Hemmes, & Dennis E. Desjardin** 215

Taxonomy of the *Russula xerampelina* group. Part 2. Taxonomic and nomenclatural study of *Russula xerampelina* and *R. erythropoda* **Slavomír Adamčík** 241

New species of *Oudemansiella* and *Pouzarella* (Basidiomycetes: Agaricales) from Puerto Rico **Timothy J. Baroni & Beatriz Ortiz** 269

First record of *Neolentinus schaefferi* in the Americas **Bernardo E. Lechner & Jorge E. Wright** 281

New records of the Corticiaceae from mainland China **Sheng-Hua Wu** 289

Cladistic analysis of the Polyporaceae using morphological characters **Seon-Young Kim & Hack Sung Jung** 295

Phylogenetic evaluation of *Polyporus* s. str. based on molecular sequences **Kwan Soo Ko & Hack Sung Jung** 315

New records of *Ramariopsis* from Mexico **Ricardo García-Sandoval, Margarita Villegas, & Joaquín Cifuentes** 323

Myxomycetes of the State of Bahia, Brazil: historical review and current situation **Artistóteles Góes-Neto & Laise de Holanda Cavalcanti** 335

Biosystematics of the myxomycete *Arcyria cinerea* **Jim Clark, Martin Schnittler, & Steven L. Stephenson** 343

Notes on two violet species belonging to Physarales (Myxomycetes) **A. Castillo, G. Moreno, C. Illana, & H. Singer** 347

Two additional species of *Verrucisporota*, one with a *Mycosphaerella* teleomorph, from Australia **Vyrna Beilharz & Ian Pascoe** 357

A new species of *Ascochyta* from leaf spots *on Peperomia* spp. in Brazil **José Mauricío Pereira & Robert Weingart Barreto** 367

Teichosporaceae, another family in the Pleosporales **Margaret E. Barr** 373

Phytophthora cinnamomi var. *robiniae* var. nova on black locust in Jiangsu province of China **H. H. Ho** 391

Three new *Pseudocercospora* species, one with a *Mycosphaerella* teleomorph, from *Kennedia* in Australia **Vyrna Beilharz, I. G. Pascoe, & D. G. Parbery** 397

Notes on two corticolous lichens from South America **María Inés Messuti & Lidia I. Ferraro** 409

A new *Dictyosporium* species from *Musa acuminata* in Thailand **W. Photita, P. Lumyong, E. H. C. McKenzie, K. D. Hyde, & S. Lumyong** 415

New combinations and records of lichenized-fungi from southern South America **Alan M. Fryday** 421

New species of the lichen genus *Coccotrema* from southern South America **María Inés Messuti** 429

Amandinea cacuminum: a new combination (Physciaceae, lichenized Ascomycetes) **H. Mayrhofer & J. W. Sheard** 437

Pseudopaulia tessellata, a new genus and species in the Lichinaceae (lichenized Ascomycotina) from Socotra, Yemen **Matthias Schultz** 443

A new name for *Sporidesmium fuscum* Gulis & Marvanová **Ludmila Marvanová & Vladislav Gulis** 451

Trechispora antipus sp. nov., une seconde espèce bisporique du genre *Trechispora* (Basidiomycota, Stereales) **Gérard Trichies & Ben Schultheis** 453

Phacellium stephanandricola sp. nov. on *Stephanandra* **Hyeon-Dong Shin & Jeong-Dong Kim** 459

The Hypocreaceae of China IV. Some new records of the genus *Hypocrea* from China **Pei-Gui Liu, Xiang-Hua Wang, Fu-Qiang Yu, & Huan-Di Zheng** 463

Book reviews and notices **David L. Hawksworth** 475

Instructions to authors: important changes and updates 489

News: Mycologia online site is launched **Jim Ginns** 491

Nomenclatural novelties proposed in volume 82 493

Author index 495

Index to fungous and lichen taxa 499

Reviewers 521

Publication date for volume 81 521

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ALTERNARIA THEMES AND VARIATIONS (287-304)
SPECIES ON CARYOPHYLLACEAE

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717 Thornwood Road, Crawfordsville, IN 47933

ABSTRACT

A continuation of a series of papers primarily on *Alternaria*, in this instance for phaeodictyosporic taxa described from hosts/substrates in the Caryophyllaceae. Of the 24 names published validly or invalidly for this group (1876 to date), 12 are retained for identifiable taxa in *Alternaria* and *Stemphylium*. Of these 12 names, seven are presented in novel formats, including *A. nobilis* (syn. *A. dianthi*; on *Dianthus caryophyllus*), *S. bubakii* (on *Silene nutans*), *A. vaccariae* (on *Vaccaria pyramidalis*), *S. trisectum* (on *Silene inflata*), *A. ellipsoidea* (on *Dianthus barbatus*), *A. juxtiseptata* (on *Gypsophila paniculata*), and *A. subelliptica* (on *G. paniculata*). A diagnostic key to the nine species retained in *Alternaria* is provided.

Additional Keywords: *Dianthus*, *Gypsophila*, *Saponaria*, *Silene*, *Stemphylium*, *Vaccaria*.

XXIX. ALTERNARIA AND STEMPHYLIUM TAXA ON CARYOPHYLLACEAE

Twenty-four names have been published for *Alternaria*-related and *Macrosporium*-named taxa described from hosts or substrates in the Caryophyllaceae in the period 1876 through the present. The known pathogens in this host-defined group of taxa have not been discussed previously by me in these *Alt.T&V* notes. The pathogens include taxa usually found on species of *Dianthus* L., *Gypsophila* L., *Saponaria* L., and *Vaccaria* Wolf—all hosts that are commercially valuable in horticulture and in the florist trade.

Each named taxon of this group is given an entry below, in chronological order of publication of its basionym. Synonyms are treated out of order under accepted/correct names. Typification elements are indicated.

Distinguishing the major large-spored taxa found on Caryophyllaceae from each other on the basis of conidium characters presents the same problem that is found in many species-groups of *Alternaria*, namely, that conidia of similar shape and size can be found in population samples of the several different taxa. The problem is particularly burdensome in studying field specimens, for which the growth conditions and stage of development are essentially unknown. Nevertheless, it often is possible to follow juvenile-to-mature patterns of growth and septation in field samples, which permits identification.

Of great help with this particular group have been comparison of isolates under controlled conditions of culture and direct examination of colonies at 40X as well as at higher magnifications. Culture conditions are those standardized for all of these *Alt.T&V* studies: inoculated PCA, V-8, and Hay decoction agars held separately in the sections of each Y-plate, maintained at moderate temperatures (ca. 22C), without humidity control (a gradually drying atmosphere in unsealed plates), under a fluorescent light/dark cycle of 8/16 hrs. (Simmons 1995). In this current paper, all illustrations of living material are from cultures grown on V-8 juice agar.

287. Alternaria saponariae (Peck) Neergaard (1938), Aarsberet. J. E. Ohlsens Enkes Plantepat. Lab. Nr. 3: 6.
Fig. 204, 205

≡ *Macrosporium saponariae* Peck, New York State Mus. Nat. Hist., 28th Ann. Rept. [for 1874]: 62. 1876. Holotype [**NYS**]: *Helminthosporium Saponariae Pk., Loc. Greenbush, Leg. C. H. Peck, Macrosporium, 28th Rept. 62. 1876.*; EGS 08-099.

C. H. Peck provided the first description of an *Alternaria* pathogen on a caryophyllaceous host when he presented *Macrosporium saponariae* occurring on dry, round leafspots of the wild form of *Saponaria officinalis* L. ("soapwort, bouncing Bet"). Peck gave lengths of 50.5–91.4µm (".002′-.0036′") for oblong-clavate, 5-10-septate conidia, including a very short "peduncle" [beak]. Many conidia of the type (EGS 08-099) are in this size range, but many others reach a length of ca. 120µm and have as many as 15 transepta.

Alternaria saponariae has not been collected frequently, judging from holdings of many herbaria visited; and no isolate of the taxon is listed in catalogues of major culture collections such as ATCC, CBS, and IMI. Additionally, the taxon inevitably has been misunderstood by anyone following Neergaard's discussion of the name (including me in earlier days). Neergaard (1945, p. 169-170) considered the taxon "undoubtedly" identical with *A. dianthi* Stevens & Hall (1909), basing his opinion in part on the *A. dianthi* holotype (**NY**; EGS 02-121) and on a non-type but correctly identified specimen of *M. saponariae* (**NY**; EGS 06-002). However, his illustration of conidia (l.c., p. 173) emphasizes relatively narrow immature spores of *A. dianthi*, which are not diagnostic for the species, that is, they could represent immature conidia of either *A. dianthi* or *A. saponariae*. Also, though Stevens and Hall typified *A. dianthi* with conidia as long as 123μm, I can find none longer than 100μm in an excellent ex-type slide preparation, and Neergaard illustrated none longer than 90μm from the same specimen. *A. dianthi* is discussed in detail below as a synonym of *A. nobilis* (Vize) E. G. Simmons (*Alt.T&V* 288).

Wild *Saponaria officinalis* occurs so commonly along roadsides and field borders in midwest U.S.A. that I have not been surprised to find excellent specimens of leafspots with typical *A. saponariae* as soon as the host was recognizably blossoming in late June in central Indiana. Examination of natural field sporulation and numerous one-conidium isolates, plus access to the type specimen and a few other herbarium deposits, make it possible to present here a more definitive picture of the taxon than has been available. Briefly, *A. saponariae* is distinguishable from *A. nobilis* (syn. *A. dianthi*) both on the basis of field specimens with mature conidia and especially through comparison of isolates in culture. It also is definable, in hindsight, as a taxon different than one reported in 1999 as the agent of an outbreak of a leaf disease of *Vaccaria pyramidata* Medik. (syn. *Saponaria vaccaria* L.) in California; see *Alt.T&V* 297 below.

As Peck indicated, *A. saponariae* sporulates on well-defined circular leafspots of soapwort. A few collections of the taxon are held in herbaria, including **BPI**, **NY**, **WIS**, as noted below. Some of the herbarium specimens examined of *S. officinalis* bear distinctive sporulation that looks more like *A. nobilis* than *A. saponariae*, which suggests that taxa similar to *A. nobilis* can infect hosts other than *Dianthus*.

A few conidia from Peck's type specimen are illustrated in Fig. 204. Mature conidia from an excellent recent collection in Indiana (EGS 49-183) are illustrated in Fig. 204;

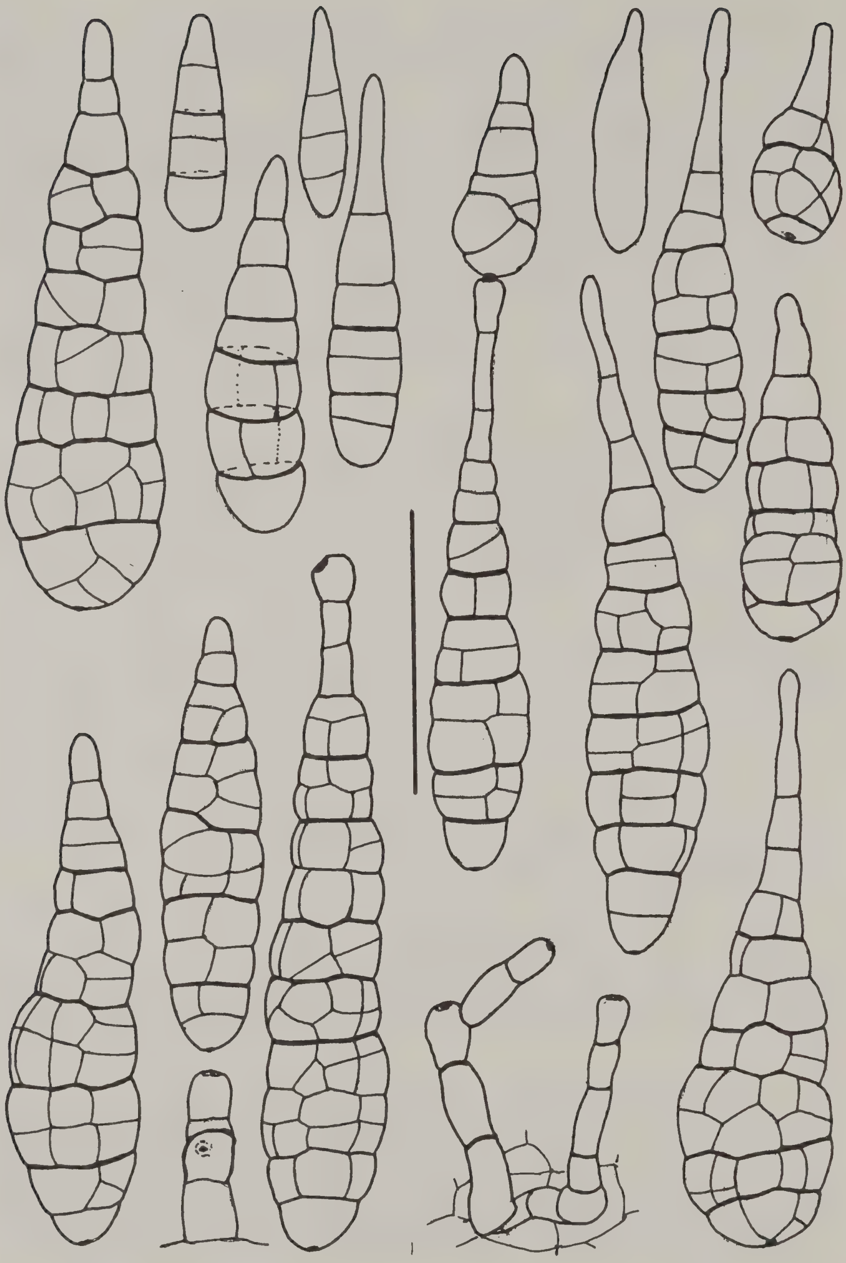

Fig. 204. *Alternaria saponariae* conidia and conidiophores: left of bar, ex holotype (EGS 08-099); right of bar, ex representative field specimen (EGS 49-183). Bar = 50μm.

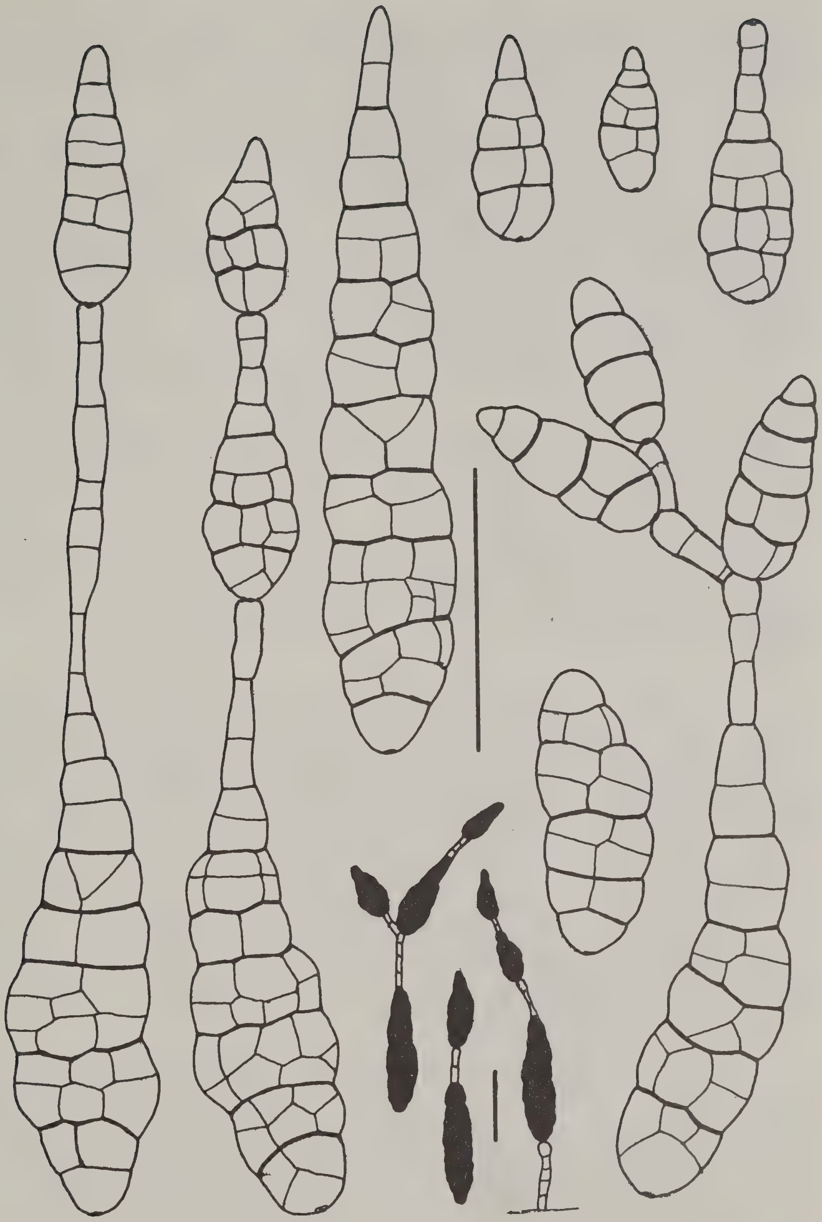

Fig. 205. *Alternaria saponariae* conidia, conidiophores, and sporulation habit: ex representative isolate (EGS 49-182). Bars = 50μm.

one of several identical 1-conidium isolates from this specimen was used for the comparative culture observations given below (EGS 49-182) and for illustrations in Fig. 205.

Conidia in recent field collections show the developmental stages and essentially the same size range, color, and septation found in the type specimen. Conidiophores on the host are solitary or loosely associated, ca. 40 x 5-6µm, with a single apical conidiogenous site or occasionally with a short branch lateral to the primary conidiogenous site. Juvenile conidia may begin to produce a beak extension when they still are a single ellipsoid cell ca. 35 x 8µm. Conidia develop through various intermediate morphologies, becoming either broadly ovate with a broadly rounded apex or obclavate with a sturdy, gradually tapered (never filamentous) apical extension of the spore body. Maximum size range of field conidia is ca. 90-110(-130) x 17-25µm, with 11-15 transepta and 1-3(-4) longitudinal and oblique septa in most of the central transverse divisions. Conidia are a dilute pale brown with slightly darker septa. Conidium walls are without ornamentation. The narrowed apical extension of the conidium body often becomes converted into a slightly wider cell, which functions as a conidiophore in production of a short chain of 1-2 conidia.

Representative isolates of *A. saponariae* (EGS 49-182 and several siblings) grow readily under standard culture conditions. Sporulation is dense (colony center) to abundant on V-8 and PCA agars. Most conidiophores arise directly from the agar surface; aerial sporulation is minor and occurs only on wispy hyphae that develop during the dark phase between light exposures. Conidia may remain solitary on a conidiophore. However, to a very great extent they are produced in chains of two or three, with a minor percentage of up to 5-6 units. The initial conidium almost always reaches a size in the maximum range for the taxon; and it is the preponderance of these very large primary conidia that is one diagnostic microscopic (50X +) character for *A. saponariae*.

In V-8 culture of *A. saponariae*, primary conidiophores become ca. 80-150 x 5.5µm. Primary conidia are mostly long obclavate with the apical quarter or third narrowing into a sturdy beak. The beak apex commonly converts into a slightly wider secondary conidiophore, which may comprise only 1-2 short cells but sometimes is as long as 60µm. The secondary conidiophore produces a solitary conidium or, often, a chain of 4-5(-7) units of decreasing size and septation. Primary conidia have an upper size range of ca. 80-160 x 23-29µm, up to 17 transepta and 1-4 longitudinal or oblique septa in all but the basal and beak cells. Some (5-7) of the primary transepta in the larger conidia are conspicuously constricting. Secondary septa often are strikingly irregular in their pattern of oblique insertion, which results from the tendency of many large conidia to be laterally asymmetrical. Conidium color is a dull medium brown; septa are slightly darker. Conidium walls appear to be smooth.

In addition to my collections in Indiana (Simmons, 2001), *A. saponariae* is known to me from herbarium holdings, at least from Canada (**BPI** and **NY**, J. Dearness, 1923), Jamaica (**BPI**, APHIS intercept, 1975), Rumania (**NY**, Tr. Săvulescu, 1932), and the U.S.A., New York (**NY**, C. L. Shear, 1893) and Wisconsin (**WIS**, J. J. Davis, 1936), respectively EGS 49-116, 03-067, 49-134, 03-075, 06-002 and 02-018.

288. Alternaria nobilis (Vize) E. G. Simmons, comb. nov.

Fig. 206, 207

≡ *Macrosporium nobile* Vize (basionym), in M. C. Cooke (1877), Grevillea 5: 119. Lectotype [**K**; EGS 11-014]: *Macrosporium nobile Vize, on carnation, Forden 1877.* (Identifiable, probable isolectotype [**IMI** 57062; EGS 10-027]: J. E. Vize. Micro-Fungi Britannici. 63. *Macrosporium nobile* Vize. 1878.)

= *Alternaria dianthi* Stevens & Hall (1909), Bot. Gaz. 47: 413. Holotype [**NY**; EGS 02-121]: *Alternaria Dianthi S. & H., on Dianthus caryophyllus, Raleigh, N. C., B. B. Higgins, coll. Jan. 20, 1909.* [Orig. North Carolina Agricultural Experiment Station 1793.]

= *Macrosporium dianthi* Stevens & Hall, in Bewley (1923), Diseases of Glasshouse Plants, p. 106 [publ. invalid].

The name *Macrosporium nobile* Vize represents the same *Alternaria* species that later became known commonly as *Alternaria dianthi* Stevens & Hall (1909). Although Stevens and Hall devoted considerable amounts of fungus culture and inoculation work to study of *Alternaria* blight of carnation, they considered it "unjustifiable" that "an attempt be made to identify this form with some of the seven or more species of *Macrosporium* infecting the pink family."

Guba (1945, p. 6), in summarizing what had been published on the carnation disease, presented a misguiding observation and an insupportable conclusion that "The type specimen, Vize, Micro Fungi Brit. No. 63 . . . bears only the

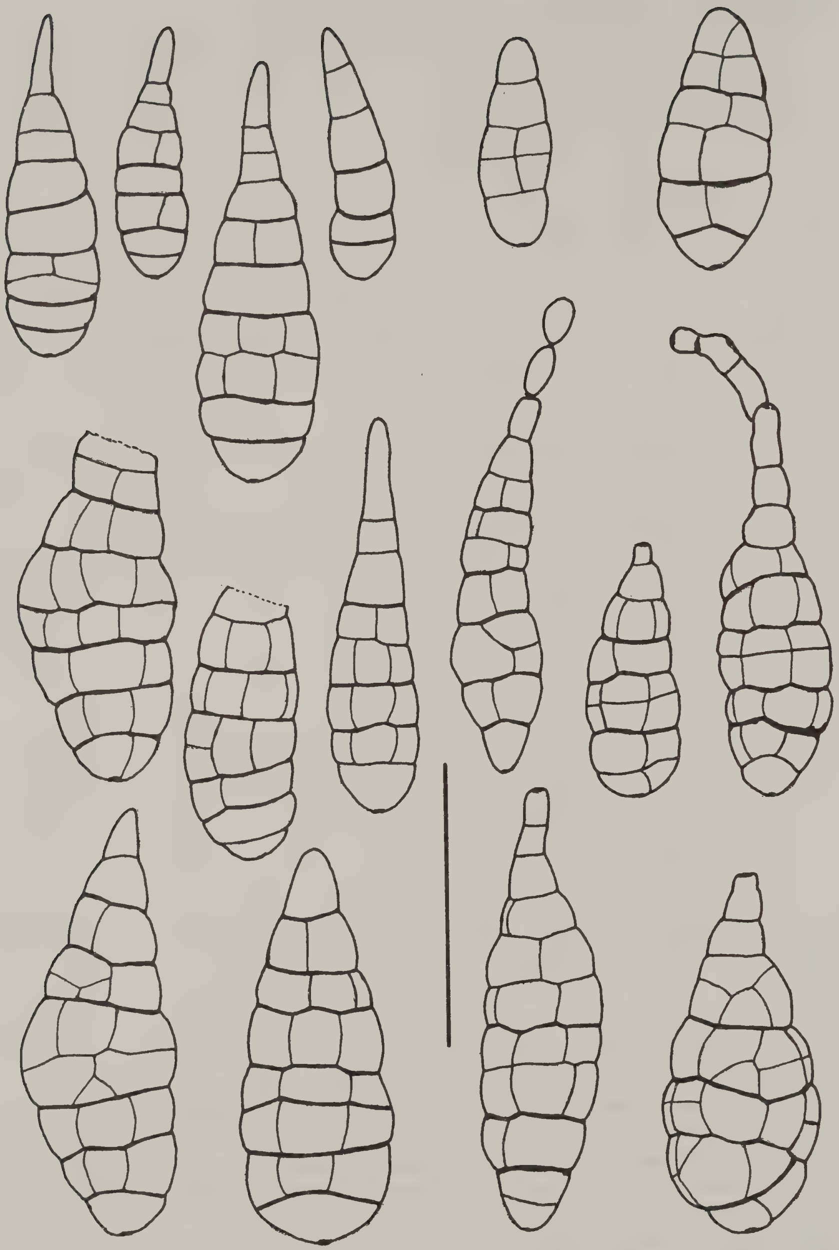

Fig. 206. *Alternaria nobilis* conidia: left of bar, ex lectotype and isolectotype (EGS 10-127, 11-014); right of bar, ex representative field specimen (EGS 05-139). Bar = 50μm.

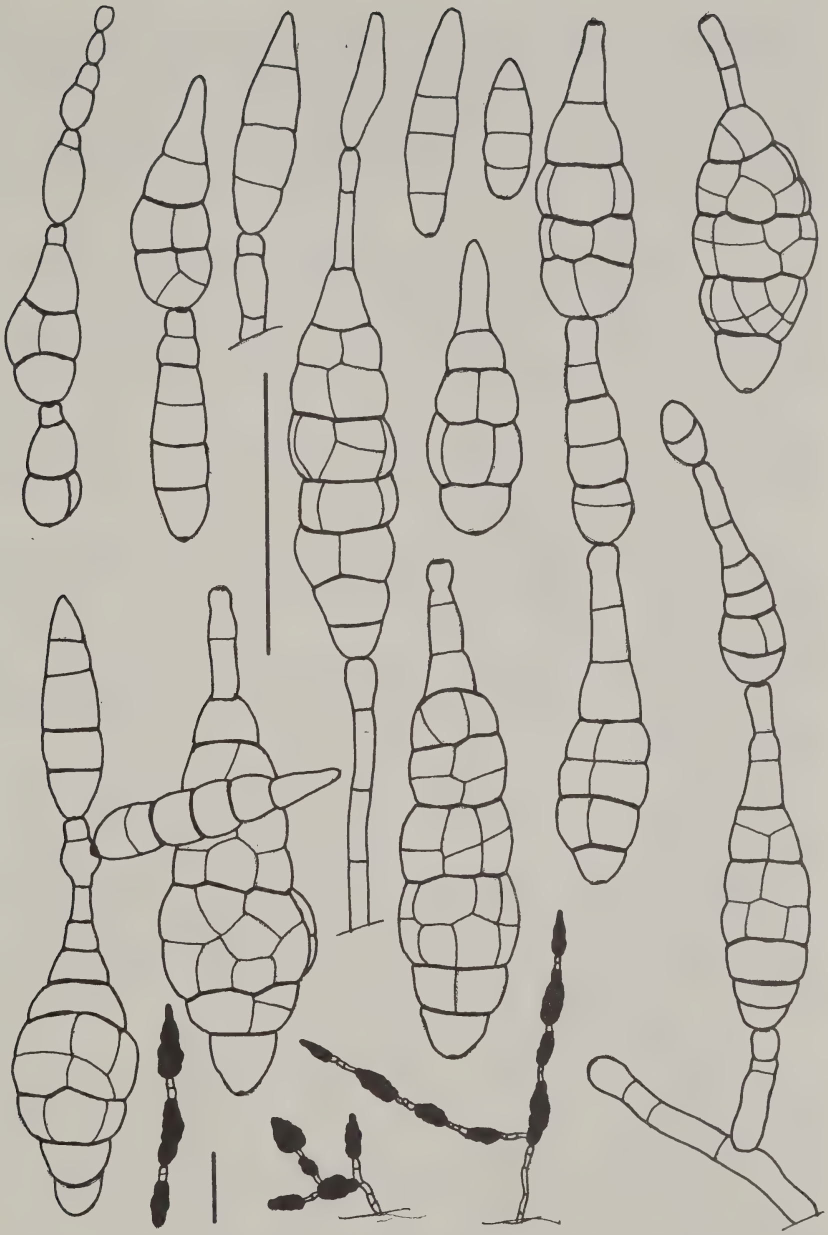

Fig. 207. *Alternaria nobilis* conidia, conidiophores, and sporulation habit: ex representative isolate (EGS 49-152). Bars = 50μm.

fungus *Heterosporium echinulatum*" and that "The Macrosporium described by Vize may be regarded as secondary and saprophytic." Quite to the contrary, the **IMI** example of Vize's exsiccatus no. 63 (**IMI** 57062; EGS 10-027) bears conidia of what Guba called *A. dianthi*, now known correctly as *A. nobilis*. (For comments on use and misuse of so-called "duplicate specimens," attention is invited to Simmons, 2000, p. 21: "An Aside on Lectotypes from Divided Collections.")

The Vize basionym is legitimate as published, represents a recognizable fungus and disease relationship, and was in use in the literature on carnation diseases in both Europe and America before the 1909 of Stevens and Hall's work. There is no reason to perpetuate the taxonomic indifference and misguidance of Stevens, Hall, and Guba, and no practical reason to consider nomenclatural conservation for "*Alternaria dianthi*," which name in any case represents a fungus that is not at all the most commonly encountered *Alternaria* pathogen of carnations. (See *Alt.T&V* 299, *A. dianthicola* Neerg.)

Typifying elements of the Vize specimen are illustrated in Fig. 206. Sporulation from a correctly identified early field specimen from New York, U.S.A., also is represented in Fig. 206 (K. F. Baker, Ithaca, N.Y., 9/26/47, on *Dianthus caryophyllus*; EGS 05-139). A more recent isolate from the U.K. (**IMI** 280151; EGS 49-152) is in more stable condition and is used as the culture basis for an extended description of the taxon (Fig. 207).

Some conidia in the Vize material have a broken apex. Nevertheless, the shape, size, and septation of the largest intact and damaged spores are consistent with those found in numerous more recent specimens from *Dianthus*. Type conidia are broad-ovate and usually taper into a sturdy beak portion that can make up about one-quarter of the length of the spore body. Conidia are 50-75+ x 18-28μm and have 7-9 transepta and 2-3 longisepta in most of the widest transverse sections.

The sporulation pattern in field material shows well in the Baker specimen (EGS 05-139), with conidia produced in small branching clumps of ca. 5-7 units. Conidia are broadly ellipsoid or ovoid, often with a 1-cell apical secondary conidiophore; they are as large as ca. 50-70 x 17-28μm and have 7-9 transepta and 1-4 longitudinal and oblique septa in most of the central transverse sections.

Recent attempts to obtain carnation specimens infected with *A. nobilis* for isolation work have been unproductive, quite possibly because current commercial horticultural practice effectively controls infection in the greenhouse.

A stable representative isolate of *A. nobilis* from the U.K. (IMI 280151, ex carnation, 1983; EGS 49-152) grows readily under standard culture conditions. Sporulation is abundant to dense on V-8 and PCA agars. Vegetative mycelium of the colony is almost entirely within the agar substrate; conidiophores therefore arise from submerged hyphae directly up through the agar surface. Conidia rarely remain solitary on a primary conidiophore. Unbranched chains of a few conidia occasionally occur, but characteristically and dominantly the sporulation pattern is similar to that seen in nature, that is, conidia are produced in branching clumps, which in culture commonly comprise 20-40 units. Conidial clumps derive both from branched conidiophores and from secondary conidiophores that originate in body cells of mature conidia.

It can be seen (40X) that conidium size and position in a chain do not correlate; although the largest conidium in a chain may be (and usually is) the primary basal unit, very often it is median or even subterminal in a chain of 5-7 small and large units. This contrasts remarkably with *A. saponariae*, in which the primary conidium typically is by far the largest unit in any chain produced.

Primary conidiophores in V-8 cultures of *A. nobilis* seldom are longer than 100μm; most are half as long, ca. 6μm wide, and occasionally branched. Primary conidia can be any size up to the maximum range of ca. 70-80 x 20-28μm. Spores produced subsequently within branching chains show some tendency to be decreasingly smaller; but as noted above, there is, in general, not a positive correlation between chain position and conidium size. Conidia are ovoid or ellipsoid, usually have a sturdy 1-2-celled beak portion that may become functional as a secondary conidiophore, and in the maximum size range have 9-11 transepta and 1-4 longitudinal and oblique septa in most of the transverse sections; 3-4 of the main transepta are moderately constricting. Conidium color is a medium brown with darker septa; conidium walls are smooth or, infrequently, inconspicuously punctulate.

289. Macrosporium seguierii A. Allescher (1894), Hedwigia 33: 75.

The taxon was described from a collection: *Hab. in foliis caulibusque emortuis Dianthi Seguierii. München: in horto botanico 9.93 leg. Allescher.* In his type description Allescher noted clavate [obclavate?], 3-10-muriformly-septate conidia 30-70 x 10-16μm.

I have not had the opportunity to examine the type specimen. Neergaard (1945) wrote that he saw type material lent to him by the Forstbotanisches Institut, München. His illustration of conidia (l.c., p. 90) fits his concept of "*Alternaria tenuis [alternata] auct. sensu str.*" Conidium dimensions calculated from Neergaard's drawings have a range of 25-50 x 10-18µm; conidium shape and septation show no unique diagnostic character. Accepting Neergaard's observations as representative of the taxon, and since they do not differ significantly from the type description, it is not possible to reach a conclusion other than that *Macrosporium seguierii* is an *Alternaria*—and that, as a field specimen, it is indistinguishable from large numbers of other loosely defined representatives of the genus.

290. **Macrosporium truncatum** Lambotte & Fautrey, in Fautrey and Lambotte (1895), Rev. Mycol. 17: 70.

Lectotype [**UPS**] (chosen here): *Macrosporium truncatum, sp. n. . . . Sur tiges sèches de Silene nutans. Été 1894. F. Fautrey*; (EGS 11-091). This specimen packet contains a manuscript description that duplicates the published type description plus some drawings; both enclosures are attributed to the French authors.

Fautrey apparently sent type material to **UPS**. He also distributed material under the name *M. truncatum* as no. 6752 of Roumeguère's *Fungi selecti [gallici] exsiccati*, of which Fautrey was editor at the time (1895).

The lectotype portion at **UPS** contains a few stem fragments with sparse black growth scattered over the surface. The growth is of conidiophores and conidia of a *Stemphylium*, which is a reasonable interpretation of the type description and the accompanying illustration (l.c., Pl. CLIII, fig. 4) and of the similar drawings attached to the **UPS** specimen.

Examination of two packets of Roumeguère's *F. sel. exs. 6752* (**NY**; EGS 04-139, 04-140) reveals a substrate of plant material woven into a kind of fine basketwork. Dark sporulation present in both packets is mostly conidia of small-spored *Ulocladium* and *Alternaria*. *Stemphylium* conidiophores or conidia were not found. The striking difference between substrates in the lectotype and in the exsiccati suggests that the specimens have different origins and, likely, that the woven substrate was distributed in the wrong packets.

The type illustration is of subglobose conidia drawn with as many as 26 cells and with a well-defined median constriction. These match the type description, whereas conidia in the exsiccati have relatively few cells and no resemblance to the type illustration. Elliott (1917), in his groupings of *Alternaria* conidium morphologies, placed *M. truncatum* with his "*Alternaria tenuis* group"; he had examined a packet of the exsiccatus but failed to note that the fungus present had little resemblance to the type description and illustration. (Again, I invite attention to Simmons, 2000, p. 21: "An Aside on Lectotypes from Divided Collections.")

Macrosporium truncatum is a *Stemphylium* taxon similar to *S. herbarum* E. G. Simmons (1986) in the size and irregular pattern of muriform septation of their conidia, but not similar to *S. botryosum* Wallr. (1833), whose conidia exhibit a more uniform distribution of longitudinal septa.

291. **Stemphylium bresadolae** Neergaard (1945), Danish Species of *Alternaria* and *Stemphylium*, p. 194; non *Stemphylium congestum* Newton, Phytopathology 18: 576. 1928.
Fig. 208

≡ *Macrosporium congestum* Bresadola (1897), Malpighia 11: 323. Holotype [**S**, herb. Bresadola]: . . . *Bres. n. sp., 421bis; unicum! Riva-Valdobbia, 17 Lugl. 91, Sul caudice legnosa del Dianthus caryophyllus. Ab. Carestia*; (EGS 09-134).

≡ *Alternaria congesta* (Bresadola) Joly (1964), Encycl. Mycol. 33: 198.

Bresadola included some pencil drawings of conidia on the type packet of his *M. congestum*. The drawings match the type description (ovoid, 3-7-muriformly septate, 31-75 x 18-36μm) and are essentially the same as ones published by Neergaard (1945) after his examination of the type, and here as Fig. 208 after mine. However, neither Bresadola nor Neergaard noted the distinctive conidiophores of the taxon present in the specimen, which are conspicuously and typically those of species of *Stemphylium* Wallr. (sensu Wallroth 1833, Wiltshire 1938, and Simmons 1969, but not sensu Neergaard in op.cit.). Partial conidiophores of the type are as large as 50-80 x 8μm and have as many as four percurrent proliferations 12-15μm wide.

Neergaard chose *Stemphylium* correctly for the Bresadola material, but suggested that it should be grouped in his subgenus *Pseudostemphylium*. His concept of *Stemphylium* subgenus *Eustemphylium* (l.c., p. 361) is correct in that it is based on and includes taxa congeneric with the type species *S. botryosum* Wallr. (1833). However, his *Stemphylium* subg. *Pseudostemphylium* (l.c., p. 321) includes a mixture of taxa of *Ulocladium* Preuss (1851) and of a few taxa of the *Alternaria radicina* species-group (Simmons 1995). *S. bresadolae* Neerg. is a typical, i.e., "Eu"-*Stemphylium* in all anamorphic characters.

As for *Alternaria congesta* (Bres.) Joly, there is practically no cited evidence that Joly (1964) examined specimens essential to the kind of nomenclatural revisions in which he indulged. Although he did not distinguish species making up Neergaard's subgenus *Pseudostemphylium* generically from a wide range of *Alternaria* morphologies, he at least was consistent, however incorrectly, in treating *M. congestum* Bres. (and *S. bresadolae* Neerg.) as an *Alternaria*, presumably on the basis of Neergaard's treatment of the type.

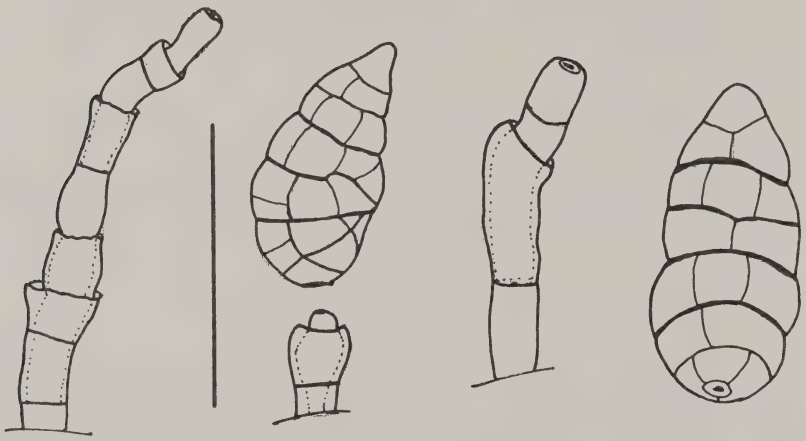

Fig. 208. *Stemphylium bresadolae* conidia and conidiophores: ex holotype (EGS 09-134). Bar = 50 μm.

292. **Macrosporium dianthemphus** H. H. Hume (1900a), Fla. Agr. Expt. Sta., Rept. 1899-1900: 44.

Lectotype, chosen here [**NY**]: H. Harold Hume's *Fungi of Florida* no. 73. *Macrosporium Dianthemphus n. sp., on Dianthus sp.; Coll. Lucia McColloch, Lake City. June 16, 1900*; (EGS 03-038).

Hume distributed dead capsules of a *Dianthus* sp. in his set of exsiccati (Hume, 1900b). He described conidia from the specimen as "clavate smoky black 6-10-celled, septa transverse or perpendicular 35-50 x 10-17μm; pedicel about three-fourths of the length of the spore."

Two examples of this distribution have been examined (**NY**, EGS 03-038; **BPI** 445280, EGS 49-135). A few small *Alternaria* conidia were found on the **NY** portion during concentrated efforts to discover the basis of the description. So few conidia were found (none on the **BPI** portion) that "possibly of the *A. tenuissima* species-group" is the only justifiable opinion I can give.

293. **Macrosporium dianthi** Almeida & Camara (1903), Revista Agron. 1: 59.

Lectotype: illustration, Rev. Agron. 1(12): Tab. VIII, fig. 5, 6, 7. 1903. (Neergaard (1945, p. 194) records that "Dr. Manuel de Souza da Camara, Lisbon, has kindly informed me that the material of the species has been lost.")

Conidia of *M. dianthi* were described from dry leaves of *Dianthus caryophyllus* found in the garden of the Institute of Agronomy, Lisbon: [in transl.] conidia subclavate, mostly 5-septate, muriform, constricted at the septa, 42-53 x 15-20μm. The authors drew conidia in optical longitudinal section with 8-11 cells. There is nothing especially distinctive in these medium-size, beakless conidia. Although they appear to be *Alternaria*, nothing more precise can be said about classification of the material.

294. **Alternaria longispora** McAlpine (1904), Proc. Linn. Soc. N. S. Wales 29: 117. Fig. 209

Holotype [**VPRI** 2339]: *Dianthus caryophyllus [leaves], Sydney, N.S.W., 28/8/1903 [R. T.] Baker*; EGS 09-142 and 40-155.

McAlpine's *A. longispora* never has received appropriate consideration in the literature of taxa on *Dianthus*. Stevens and Hall (1909, p. 75) dismissed it, with good reason, as a competitor with their *A. dianthi* [= *A. nobilis*] because "the description of [*A. longispora*] does not agree with [*A. dianthi*] in size, shape, or septation of its spores." Guba (1945, p. 5) noted that McAlpine had described *A. longispora*; Guba compared conidium type measurements (100-160 x 12-15μm) with a variety of measurements reported for *A. dianthi* (including 26-123 x 10-20μm for its type).

Neergaard (1945, p. 193 and fig. 63) was able to examine a slide preparation lent by **VPRI** from McAlpine's 28/8/1903 type specimen. However, he declined to give a firm opinion on the resemblance of the taxon to other ex-*Dianthus* taxa because no conidium in the sample was as much as 100μm long (vs. 100-160μm given by McAlpine).

Joly (1964, p. 207), citing McAlpine's conidium measurements and Neergaard's lack of success in verifying their extraordinary length, gave an opinion that the great size reported probably represented simply the effect of overmaturity, and that *A. longispora* probably was only a form of *A. saponariae*. Since Joly recorded no experience with *Alternaria* specimens on *Dianthus* other than his own, it is not surprising that he misunderstood *A. longispora* as well as all the ex-*Dianthus* taxa discussed above in *Alt.T&V* 287-293. Joly concluded that *A. saponariae* (Peck) Neerg. was the correct name for the commonly encountered parasitic carnation *Alternaria*, and that the names *A. dianthi*, *A. gypsophilae*, and *M. nobile* represented the same species. He was correct in treating *A. dianthi* and *M. nobile* (now *A. nobilis*) as synonyms for an *Alternaria* producing conidia in an upper length range of ca. 70-80μm. But his secondhand reliance on Neergaard's inconclusive comments about conidia of *A. saponariae* and *A. longispora* led him to his unsupported and incorrect conclusions indicated above for the identities of these species.

The type of *A. longispora* is morphologically unique among ex-*Dianthus* taxa. Neergaard obviously examined an unrepresentative sample of conidia, leading to his observation that none he saw was as long as 100μm. I have examined the **VPRI** type twice—the second time at the invitation of **VPRI** to evaluate the type status of McAlpine's *Alternaria* collections.

In fact, conidia of *A. longispora* are longer than those of any other *Alternaria* known from *Dianthus*. The upper length commonly reaches 160μm, as McAlpine reported; several other conidia as long as 176μm are present in the type. The conidia in my samples from the type are quite regular in form and septation, and show no evidence of what Joly suggested probably was a result of "*surmaturation*".

Conidiophores of *A. longispora* emerge singly and in tight clumps from leaf lesions; they are 30-45 x 7-9μm. Nearly all conidia develop from ovoid juveniles and become

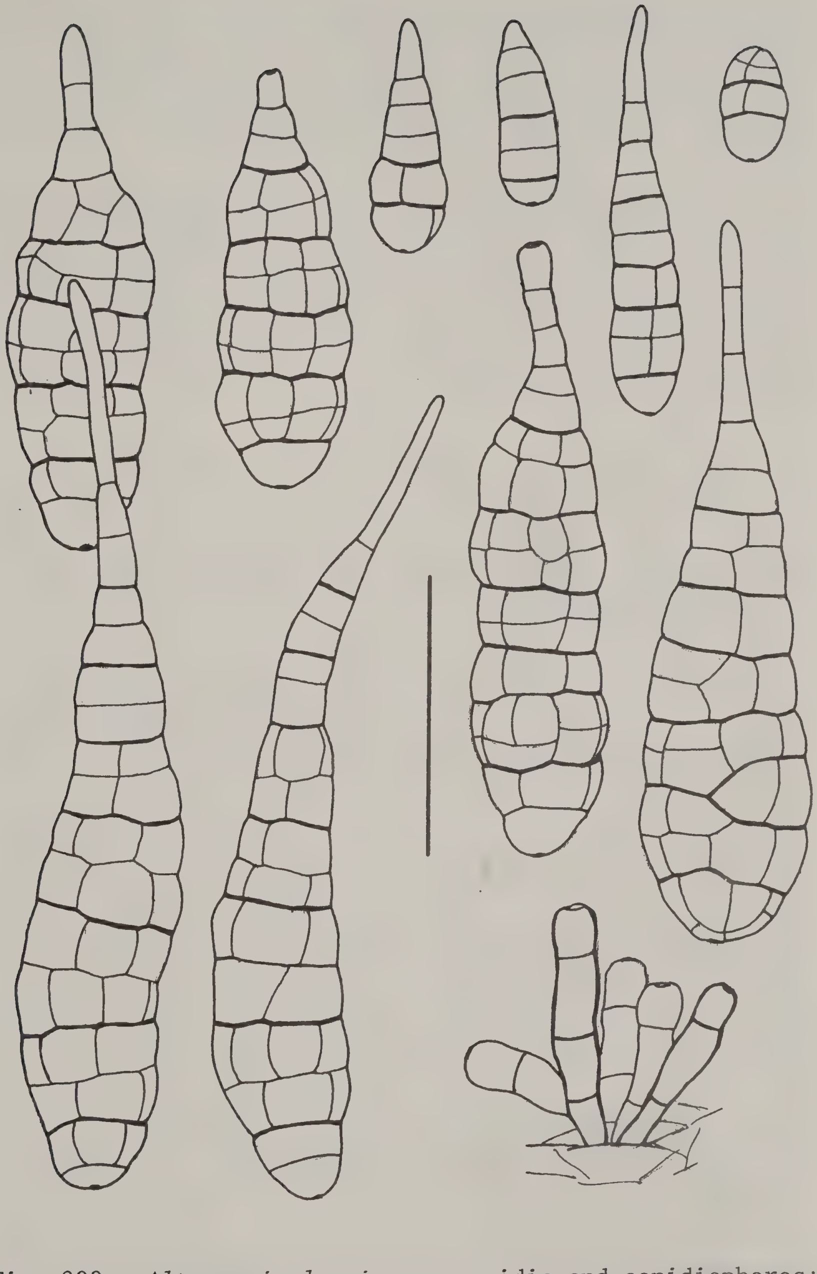

Fig. 209. *Alternaria longispora* conidia and conidiophores: ex holotype (EGS 09-142, 40-155). Bar = 50μm.

obclavate throughout further enlargement. Most conidia in the type appear to have been borne singly, but a few bear a short apical secondary conidiophore, which indicates at least occasional chain production under field conditions. The upper portion of obclavate conidia nearly always narrows gradually into a sturdy (never filamentous) beak, which may be nearly as long as the spore body.

Juvenile conidia have as many as 3-5 transepta by the time they are ca. 20-40 x 10-12μm. At maximum development they reach a size range of 125-176 x 19-26(-29)μm, and have 12-19 transepta plus 1-3 longisepta in most of the transverse body sections. The conidium body is conspicuously constricted at 4-5 of the major transepta. Conidium color is a pale yellowish tan, with septa somewhat darker. No surface ornamentation is visible.

295. **Macrosporium verruculosum** Bubák (1916), Ann. Mycol. 14: 158. Fig. 210

Holotype [BPI 445528]: *Tirolia: Gries ad Bozen in foliis vivis Silenes nutantis. 7.XI.1815. leg. Dr. W. Pfaff*; EGS 04-023.

Bubák's *M. verruculosum* is a *Stemphylium*. Conidia have the general developmental pattern of *S. vesicarium* (Wallr.) E. G. Simmons (1969) and *S. majusculum* E. G. Simmons (1969). Comparing common upper ranges of conidia shows: *S. vesicarium* 25-42 x 12-22μm; *S. majusculum* 40-50(-64) x 30-35μm; *M. verruculosum* 50-70 x 24-32μm. The type of *M. verruculosum* has large numbers of conidia that reach the maximum size indicated; comparable *S. majusculum* type conidia are shorter.

Comparison of similar taxa only on the basis of field specimens produced on different substrates under undefined conditions is taxonomically hazardous. Since characterization of the genus *Stemphylium* still is a work in progress—from viewpoints of morphology, *Pleospora* teleomorph relationships, and molecular data—I am disinclined to submerge Bubák's taxon and its enormous conidia in a quick synonymy.

Macrosporium verruculosum Bubák, as a later homonym of *M. verruculosum* Zimmermann (1878), is illegitimate (Greuter et al., 2000, ICBN Art. 53.1). Bubák's species name cannot be legitimized (except by conservation) even though *M. verruculosum* Zimm. is a *Ulocladium*, hence: ***Stemphylium bubakii*** E. G. Simmons, nom. nov. (≡ *Macrosporium verruculosum* Bubák, Ann. Mycol. 14: 158. 1916, non *M. verruculosum* O. E. R. Zimmermann, Ber. Naturw. Gesells. Chemnitz 6: 46. 1878.).

Conidiophores of *S. bubakii* are ca. 40-50μm long and 5-7μm wide until they flare apically to 8-10μm as they become conidiogenous; they are dilute tan except for the dark brown of the apical swelling. Primary conidiophores may produce at least one secondary conidiophore by means of proliferation percurrent through the primary apex. Conidia initially are ovoid; largest mature conidia are broadly ovoid, broadly ellipsoid, or very frequently oblong-cylindrical; 50-70 x 24-32μm, with 8-10 transepta and 1-4 longitudinal septa in all of the transverse sections. Conidia are conspicuously constricted at several of the transepta, yellowish tan, and, as Bubák's epithet indicated, have a verruculose ornamentation.

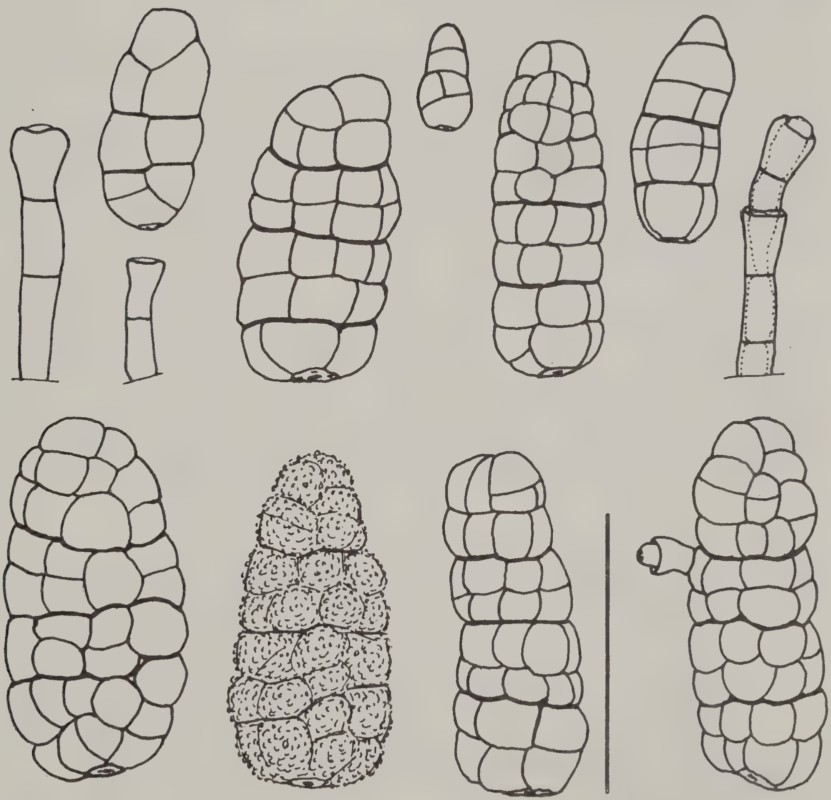

Fig. 210. *Stemphylium bubakii* conidia and conidiophores: ex holotype (EGS 04-023). Bar = 50μm.

296. **Alternaria brassicae** (Berk.) Sacc. var. **dianthi** F. Zimmermann (1924), Ochrana Rostlin 4: 9.

I have not seen the type. According to Neergaard (1945, p. 169): ". . . I have had an opportunity to examine the type material of *A. brassicae* v. *dianthi*. Unfortunately, no spores of *Alternaria* were found in this material. From a letter from Dr. Zimmermann, however, it is evident that he considers the fungus identical with *A. dianthi*."

Zimmermann's original description of a fungus from a species of carnation pink was in Czech (which supported valid publication before the ICBN Latin-requirement starting date of 1936). Some apparent but confusing spore measurements in the description were explained by a translation kindly provided by Dr. Ludmila Marvanová:

> Chains of conidia on brown conidiophores, which are 25-35 x 5-6μm, usually with 2-3 transverse septa. Conidia have two main shapes: one long-obclavate, 60-100 x 12-15μm, with 6-10 transepta, rarely with longitudinal septa; the second shape similar but more compressed, 28-45 x 14-17μm, with 3-5 longitudinal septa and usually two transverse septa; conidium walls usually distinctly constricted, somewhat darker brown than conidiophores.

It is not reasonable to expect to equate this description with one of those for other taxa published for species from *Dianthus*. Both long-narrow and short-broad conidia occur in field collections of *A. nobilis* (syn. *A. dianthi*), but their conidium septation patterns are more complex than those described by Zimmermann for his taxon. Lacking a specimen, not enough information is available to support an opinion on the identity of *A. brassicae* var. *dianthi*.

297. **Macrosporium vaccariae** T. Săvulescu & Sandu, in T. Săvulescu (1932), Herb. Mycol. Roman. no. 445.
Fig. 211, 212

Lectotype (chosen here) [**BPI** 445529]: *Hab. in foliis Vaccariae pyramidalis [pyramidata Medik.?], Bucureşti (distr. Ilfiv), 15/VII/1925. Leg. et det. Tr. Săvulescu et C. Sandu*; EGS 49-195.

Săvulescu distributed specimens of *M. vaccariae* in his set of exsiccati *Herbarium Mycologicum Romanicum* along with a printed label bearing the type description. The same *Alternaria* taxon is found in two portions examined (**BPI**, EGS 49-195; **NY**, EGS 03-072).

The fungus is essentially as typified (Fig. 211): conidia long-ovoid to long-obclavate with the apical one-third gradually tapered into a sturdy beak portion, 80-100 (-110) x 15-17μm, with 8-10 transepta and 1(-2) longisepta in 1-4 of the transverse divisions, pale brown, smooth. The apex of a conidial beak sometimes (rarely) is seen as a definite inflation but without a visible terminal pore (morphologically an incipient secondary conidiophore); this suggests that sporulation on the specimen had been a short-term event that was interrupted just before chain formation could begin.

Macrosporium vaccariae is a typical *Alternaria*. The conidia of *M. vaccariae* are a good match for mature but pre-catenate conidia of material collected in California in 1998 on diseased plants of the cultivated ornamental *Vaccaria hispanica* (Mill.) Rauschert (= *Saponaria vaccaria* L. = *Vaccaria pyramidata* Medik.).

This California material and the disease outbreak were discussed in an APS Disease Note (Koike et al. 1999). The associated fungus (Fig. 211) was misidentified there as *Alternaria saponariae* because of the lack of comparative isolates (now available) and due to a bit of overconfidence on my part. In the meantime, an adequate portion of the Săvulescu exsiccatus was found at BPI; observations based on this specimen support a decision to correct the 1999 identification of the California material and to discuss it from excellent isolates (Fig. 212) as:

Alternaria vaccariae (Săvul. & Sandu) E. G. Simmons & S. Koike, comb. nov.; basionym: *Macrosporium vaccariae* Săvul. & Sandu, Herb. Mycol. Romanicum no. 445. 1932. Lectotype: BPI 445529, Herb. Mycol. Roman. 445.

Colonies of *A. vaccariae* develop readily and sporulate abundantly on both PCA and V-8 media. Concentric rings in the colonies represent relatively dense sporulation found in areas after light exposure, alternating with less dense, partially aerial sporulation initiated during dark periods. Essentially all hyphae, both subsurface and aerial, bear conidiophores and conidia.

Conidiophores that arise directly from the agar surface are solitary (rather than in clumps), strikingly sturdy and suberect, and up to ca. 250 x 5μm; they usually bear a single apical chain of conidia but also often have one or two geniculate extensions or branches, each with a short chain of conidia. Aerial sporulating elements are long, suberect, flexuous hyphae that may bear a few short lateral branches;

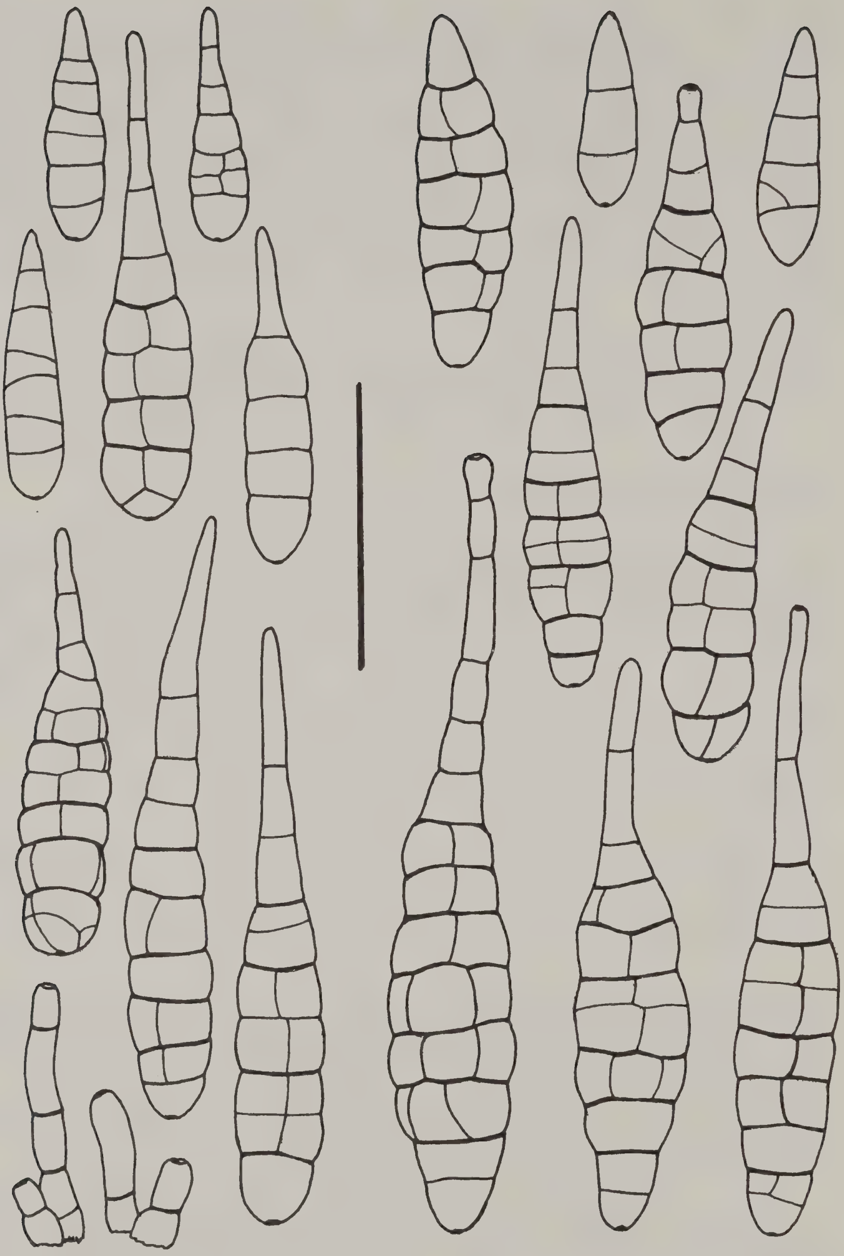

Fig. 211. *Alternaria vaccariae* conidia and conidiophores: left of bar, ex lectotype (EGS 49-195); right of bar, ex representative field specimen (EGS 47-101). Bar = 50μm.

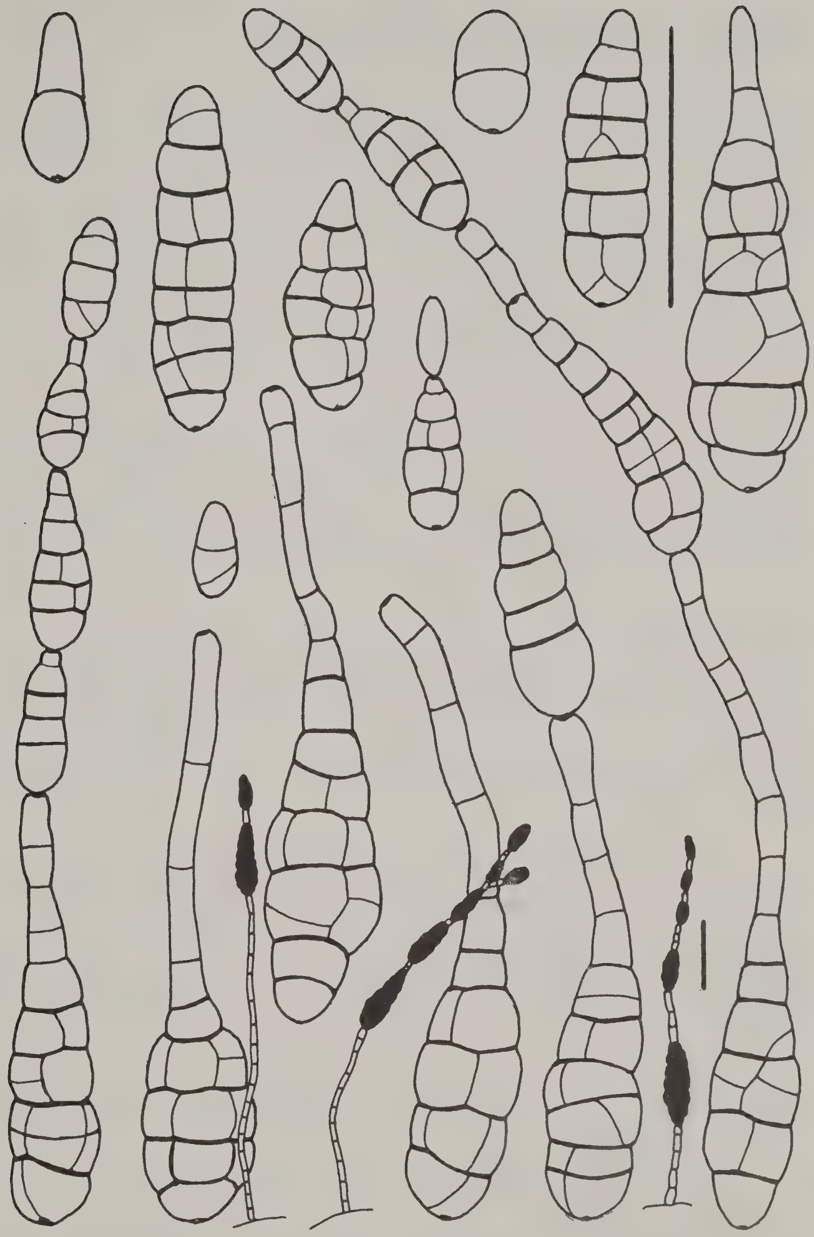

Fig. 212. *Alternaria vaccariae* conidia, conidiophores, and sporulation habit: ex representative isolate (EGS 47-108). Bars = 50μm.

these, like the main axis, become slightly swollen near their tips and produce short chains of conidia.

Conidia proliferate in unbranched chains to an overwhelming extent. However, in any spore sample there are numerous ellipsoid conidia of near-maximum size and septation that show no evidence of beak taper or secondary conidiophore production. Early growth conidia of a 4-5d colony tend to occur in chains of 5-6 spores separated by very short secondary conidiophores; younger chains that dominate the less moist and less frequently light-exposed circumference of the same colony have only 2-3 spores, the initial one of which usually has developed a long apical secondary conidiophore. Chains may contain 8-10 conidia as the colony ages.

The basic conidium shape is short or long ovate, sometimes almost elliptical, without a definable apical beak portion. In culture, the great majority of such conidia initiate a beak-like extension, either through gradual narrowing of new cells or more conspicuously as an abrupt conversion into a cylindrical secondary conidiophore.

Primary conidia in V-8 cultures commonly are ca. 70-85 x 17-19μm plus apical secondary extensions ranging from one cell, 5 x 5μm, to multicellular, ca. 50-70 x 5-8μm. The conidium body may have as many as 6-9 transepta and 1-2(-3) longitudinal or oblique septa in a few of the transverse segments; 3-5 transepta constrict and are darker than the medium grey-brown of the spore body. Most conidia appear smooth; a few cells in the broadest conidia are punctate.

It is noteworthy that conidia produced in culture do not reach the maximum dimensions noted for spores produced on the original host lesions, which have been given as 69-90(-119) x 17-21(-25)μm (Koike et al. 1999). Also, inoculation studies with *A. vaccariae* (Koike et al. 1999) have shown that the *Vaccaria* pathogen does not attack *Dianthus caryophyllus* and *D. barbatus* under experimental conditions.

298. Macrosporium trisectum A. Raabe (1938), Hedwigia 78: 85; Abb. 6. Fig. 213

Type specimen not found. According to Raabe (l.c., p. 86), his specimen was "*in Herb. Musei Botanici Berolinensis depos.*" I was not able to locate it at B. Lectotype (chosen here): illustration published with the type description in Raabe, Hedwigia 78: Abb. 6 (*Sporen und Enden von Konidienträgern*). 1938. "*Hab. in foliis vivis Silenis inflatae. . .Prope Tübingen.*"

Raabe described *M. trisectum* as having conidiophores 50-100 x 5-8μm, with the apex inflated as a series of globose to pyriform cells 11μm wide; and having oblong conidia 48-77 x 16-23μm, with rounded sections created by three distinctly constricting transepta, each section with irregular internal septation, olivaceous, verruculose.

The description fits well with Raabe's illustration of an unusual but generically typical *Stemphylium*. The type illustration is redrawn in Fig. 213 to the same scale as others in this series for future reference, in the hope that the taxon will be recognized if found again. Taxa of the *S. lycopersici* species-group have oblong, densely ornamented conidia that, under some growth conditions, are distinctly constricted at three primary transepta; their secondary septation often is obscured by dense, overlying ornamentation. One species of the group, *S. lycopersici* (Enjoji) Yamamoto (1960), is of common occurence on many different plants, particularly in hot climates or seasons. Similar but distinct taxa of the species-group have yet to be defined in publication. As a likely member of this group, *M. trisectum* needs to be maintained within its correct genus for future comparisons:

Stemphylium trisectum (A. Raabe) E. G. Simmons, comb. nov.; basionym *Macrosporium trisectum* A. Raabe, Hedwigia 78: 85. 1938. Lectotype an illustration: A. Raabe, Hedwigia 78: 85, Abb. 6. 1938.

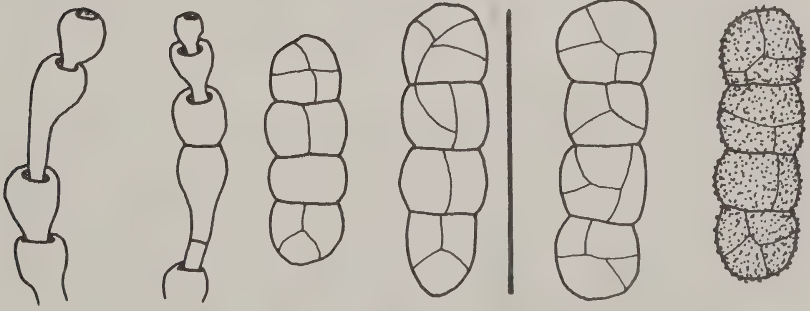

Fig. 213. *Stemphylium trisectum* conidia and conidiophores: ex lectotype illustration (redrawn/enlarged from original). Bar = 50μm.

299. Alternaria dianthicola Neergaard (1945), Danish Species of Alternaria and Stemphylium, p. 189.

Fig. 214

Holotype [CP]: *Dianthus barbatus, S. Vangede, 3.10. 1941. P. Neergaard. Type.*; EGS 11-055.

Neergaard first introduced the name in 1942 (as "*Alternaria dianthicola* n. sp.") in one of his reports for the J. E. Ohlsens Enke seed firm (Neergaard, 1942), but indicated that it would be accounted for later and, specifically, that a diagnosis for the taxon would not be cited in his report. The name, therefore, occurred in 1942 as a nomen nudum.

Neergaard's appreciation of *A. dianthicola* in his type treatment (1945) cannot be faulted fifty-five years later. In addition to recognizing its novelty, he pointed out that it was the most common pathogenic *Alternaria* species on *Dianthus caryophyllus* L. in Denmark, and that it was present in more than one-third of *D. caryophyllus* seed lots tested in 1941-1944. He found it also on seeds of *D. barbatus* L. and typified it from that host. His observations quite likely would apply to other countries today, in that, even in my less broad experience with *Alternaria* isolates ex-*Dianthus*, collections of *A. dianthicola* have proved readily available whereas those of *A. nobilis* seem to be scarce.

Narrow elongate conidia of *A. dianthicola* develop in chains of 4-5 units—consistently and abundantly on my standard media (PCA, Hay, V-8), just as Neergaard reported them to do on his nutrient-rich malt agar and on inoculated seedlings of *Dianthus* and *Gypsophila*. The following observations are based largely on representative isolates from *Dianthus* in New Zealand (EGS 43-184, 49-026).

The *A. dianthicola* colony on V-8 agar gives a 10X impression of cottony concentric rings of growth; 40X reveals that this appearance is due to enormous numbers of conidial chains arising from conidiophores that originate at the agar surface. In the most stable isolates, non-sporulating aerial hyphae are not a prominent component of the colony. Conidiophores remain simple with a single apical chain, or they may branch or lengthen in geniculate extensions—each with a terminal chain of conidia. Simple conidiophores commonly are ca. 200-250 x 5.5μm; additional geniculate growth gives a total length of 350μm or more.

Chains of conidia are simple or sometimes branched through formation of a secondary conidiophore from a conidium

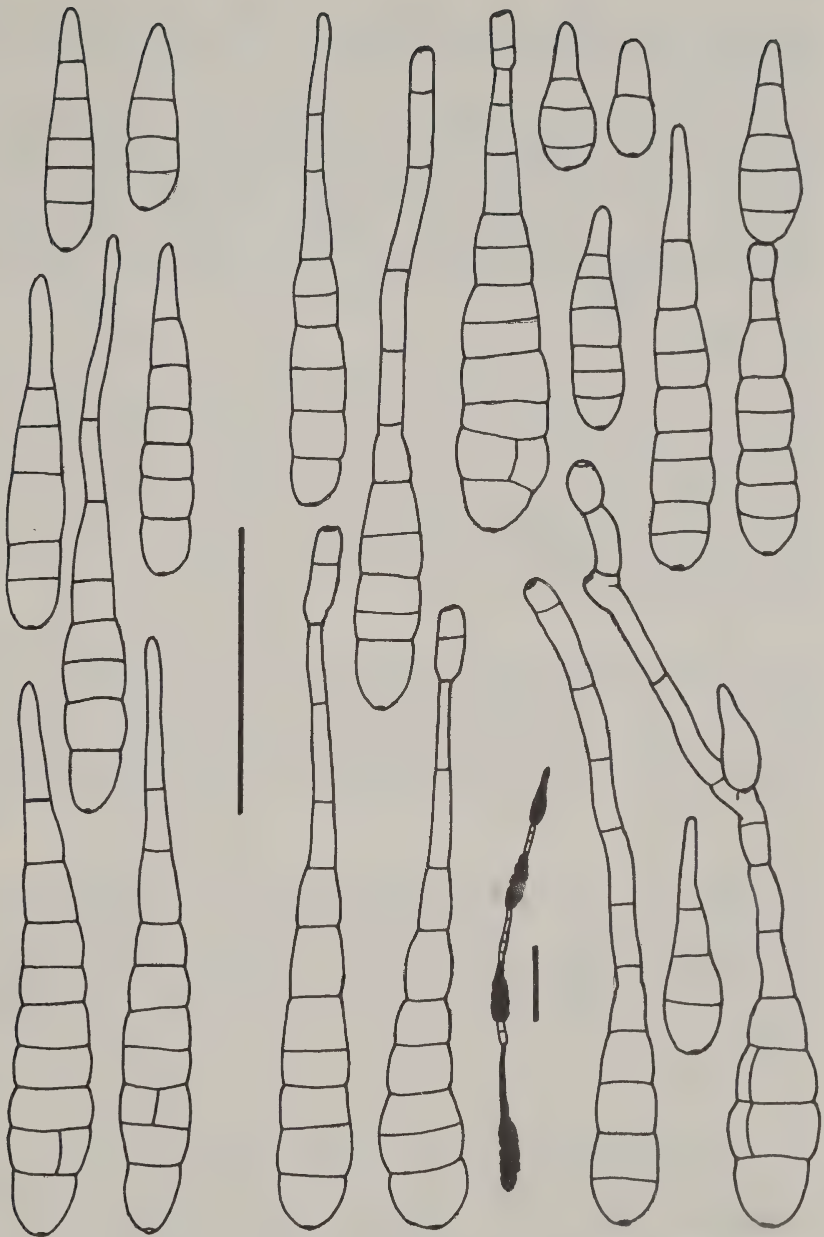

Fig. 214. *Alternaria dianthicola* conidia, conidiophores, and sporulation habit: left of bar, ex holotype (EGS 11-055); right of bar, ex representative isolate (EGS 49-026). Bars = 50μm.

body cell. A solitary conidium is rarely to be found in a well-developed colony; the norm is narrow chains in great abundance.

One of the conidium characters of *A. dianthicola* discussed and illustrated by Neergaard (l.c., p. 191) requires some reinterpretation, specifically the "beak," which he gave as 9-99µm long in cultures. The basic spore body of the *A. dianthicola* conidium is narrow-ovoid or narrow-cylindric throughout its development from a juvenile with 0-3 transepta to fully developed spores ca. 87µm long in Neergaard material (l.c., p. 190), and ca. 80-125µm in my V-8 cultures.

The structure Neergaard called and drew as a conidium beak—the long apical extension of a large percentage of conidia—sometimes is indeed a gradual narrowing of the spore body itself. For example, a conidium body of any age may narrow into an apical portion ca. 20-40µm long (rarely to 80µm) that is a part of the spore body and is a true beak of the conidium; this is the condition found in the type specimen (Fig. 214).

However, in any spore sample from culture, perhaps 80-90% of the conidia have a widened, cylindrical, apical extension that terminates in a conidiogenous site. These secondary conidiophores, which are outgrowths but not part of the conidium body, may be only one cell long, ca. 8 x 5µm, or multicellular and commonly up to ca. 80 x 6.5µm in size. Unusual lengths as great as 128µm or even more are found in ageing cultures.

The basic description of well-developed conidia in V-8 culture: ca. 80-125 x 11-18µm plus apical secondary conidiophores 8-80+ x 5-6.5µm; with 6-10 transepta and (in 1-week colonies) only rarely a single longiseptum in one of the body cells; color a dilute yellowish-tan, with 3-4 of the transepta slightly darker and constricting; outer wall smooth.

300. **Alternaria gypsophilae** Neergaard (1945), Danish Species of *Alternaria* and *Stemphylium*, p. 206.

Fig. 215

Holotype [CP]: *Gypsophila elegans alba, 3.8.1942. Frøavler Kronvold [coll.]*; EGS 11-057.

Neergaard's lack of access to specimens of critical value to his comparisons (because of wartime conditions) prevented him from establishing the identities of *Macrosporium nobile* Vize (*Alternaria nobilis*) and of *M. saponariae* Peck (*A. saponariae*) as precisely as he might have wished. Nevertheless, in the case of *A. gypsophilae* he could deduce from the type literature and subsequent publications that he had an undescribed taxon among his isolates from seeds and seedlings of *Gypsophila elegans* M. Bieb. His type specimen [**CP**] bears this out. Unfortunately, his isolate of the taxon (CBS 107.41; EGS 07-025) never has sporulated under my culture conditions; and none of several other isolates from *Gypsophila* has proved in my hands to be *A. gypsophilae*.

Neergaard's type specimen, however, supports his concept of a distinguishable taxon, as do at least two infected specimens of *Gypsophila* intercepted by USDA Plant Quarantine—one from Costa Rica (**BPI** 446289; EGS 49-130) and one from Mexico (**BPI** 446290; EGS 49-131). In giving my measurements of conidia, along with some of Neergaard's, it should be noted that his published measurements are a combination of dimensions derived from populations produced on his malt agar, on his standard dextrose/asparagine agar, and on seedlings of *Gypsophila* and *Dianthus*—without indication of which measurements came from where.

Conidia in the type are broadly ovoid or ellipsoid, beakless or sometimes with the apical one-quarter tapering gradually into a narrow-conical beak portion, 40-80+ x 12-27μm, with up to 8-9 transepta and 1-3 longisepta in several of the central transverse segments, with smooth walls dilute yellow-brown and septa slightly darker.

Neergaard noted that conidia may be formed in chains of 5-6, presumably in culture, as I found no evidence of secondary sporulation among type conidia. Neergaard's total-length measurements for conidia, 22.5-118.5μm, include dimensions of secondary conidiophores produced in culture plus those of the spore body, given as 22.5-87μm. A noteworthy feature, shown both in Neergaard's drawings from various substrates and mine from the type, is the bluntly rounded, beakless apex of many ovoid and ellipsoid conidia of various sizes.

Many conidia in the two USDA intercept specimens of *A. gypsophilae* (Fig. 215, lower right) show evidence of chain formation under field conditions, having apical secondary conidiophores as large as 35-50 x 4-7μm.

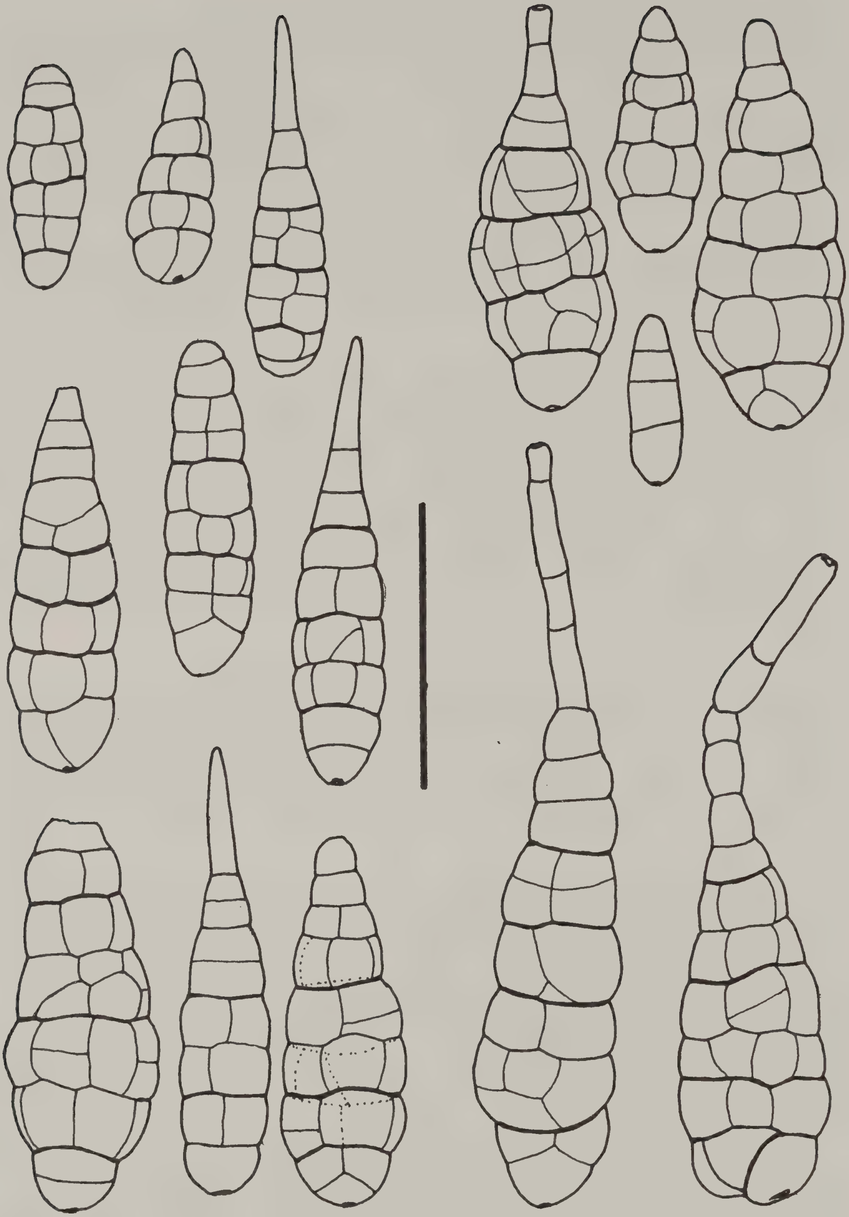

Fig. 215. *Alternaria gypsophilae* conidia: left of bar, ex holotype (EGS 11-057); right of bar, ex representative field specimens: upper, Costa Rica (EGS 49-130); lower, Mexico, maximum field development (EGS 49-131). Bar = 50μm.

301. Macrosporium melandrii M. Vasjagina (1957), Izvest. Akad. Nauk Kazakh. S.S.R., Ser. Biol., 1(13): 102.

I have been unsuccessful in attempts to find type material. An illustration (l.c., fig. 4, p. 103) could be chosen as lectotype. However, in the absence of a type specimen, the three conidia shown and the type description reveal no character that would permit discussion of the taxon as other than undefinable except probably as a species of *Alternaria*.

The collection is cited as: *in foliis Melandrii albi. Botanicus hortus oppidi Caragandae, 4.VIII 1954.* The taxon is described with olivaceous, curved, multiseptate conidiophores 32-90 x 3.5-4.8μm; and olivaceous, clavate conidia 32-60 x 6.4-16μm, with 7-10 transepta and 3-4 longisepta.

302. Alternaria ellipsoidea E. G. Simmons, sp. nov.
Fig. 216

*Ex cultura in agaro V-8 descripta. Conidiophora primaria solitaria, ca. 65-100 x 6μm. Conidia solitaria vel vulgo 2-3(-4) catenulata; ellipsoidea vel longiovoidea, ad ca. 65-90 x 16-23μm, 9-12 transverse septata, 1-3 longiseptata in aliquot segmentis transversis, luteobrunnea, vulgo laevia. Habitatio typi in seminibus Dianthus barbatus L., U.S.A. Typus: partes ex cultura EGS 49-104 desiccatae et in **BPI** 841366 (holotypus) et saltem in **IMI** (isotypus) conservandae.*

My recent attempts to obtain isolates of *Alternaria* taxa from commercial seed packets of Caryophyllaceae have had only minor success. One of the few successes was from seeds of *Dianthus barbatus* ("Sweet William"); the packet did not carry a country-of-origin label, so the seed source presumably was U.S.A. The isolates represent a previously undescribed taxon.

Colonies develop readily and sporulation is abundant on V-8 agar. The center of a 7d. colony becomes a dense black mass of short conidial chains; the periphery of the colony is more open in appearance, with large numbers of individual conidiophores arising directly from the agar base. Most conidiophores are short, ca. 65-100 x 6μm; minor numbers of much longer, ascending, apically conidiogenous hyphae are scattered throughout the colony.

Conidia may remain solitary but more commonly are borne in short chains of 2-3(-4) units. The basic shape of *A.*

ellipsoidea conidia in V-8 culture is ellipsoid; it is long ovoid when a spore body has become slightly wider and increasingly longiseptate. Even when an individual conidium produces a short apical secondary conidiophore (usually only 1-2 cells), the basic ellipsoid to long-ovoid morphology of the spore body remains evident. The initial conidium of a chain usually is much larger than those distal to it; primary conidia reach a size range of ca. 65-90 x 16-23μm. Apical secondary conidiophores seldom are larger than 10-16(-20) x 4μm; frequently the secondary conidiogenous structure is no more than a pore in the apical cell of a primary conidium. Conidia have 9-12 strongly pigmented, moderately constricting transepta and 1-3 longisepta in the broadest transverse segments. Largest cells often are subdivided by additional oblique septa. Conidium wall color is a medium yellowish brown; transepta are darker. The outer wall of most conidia appears to be smooth, but punctate ornamentation may occur on some conidia of any size.

Although primary conidia of *A. ellipsoidea* have a group resemblance to those of *A. gypsophilae*, *A. nobilis*, *A. saponariae*, and *A. vaccariae*, the sporulation patterns and morphological details differ among all five taxa:

: *A. gypsophilae* conidia often narrow gradually into a broadly tapered beak portion; conidia of *A. ellipsoidea* typically produce an apical secondary conidiophore abruptly from the bluntly rounded apical cell of the spore body.

: *A. nobilis* conidium width range is, for a high percent of the population, much greater than that of *A. ellipsoidea*.

: *A. saponariae* conidium upper size range is greater than that of *A.ellipsoidea*.

: *A. vaccariae* conidia commonly have long, thick secondary conidiophores, which is a character not seen in *A. ellipsoidea*; in addition, *A. vaccariae* is not experimentally pathogenic to the host of *A. ellipsoidea*, *Dianthus barbatus* (Koike et al 1999).

303. **Alternaria juxtiseptata** E. G. Simmons, sp. nov.

Fig. 217

Etym.: L., *juxta* (near, closely)

Ex cultura in agaro V-8 descripta. Hyphae in pagina vel subpagina distincte radiales; transepta densa, fusca, juxta posita. Conidiophora primaria solitaria vel in caespitulis ramificantibus, fusca, rigidula, ad ca. 50-100

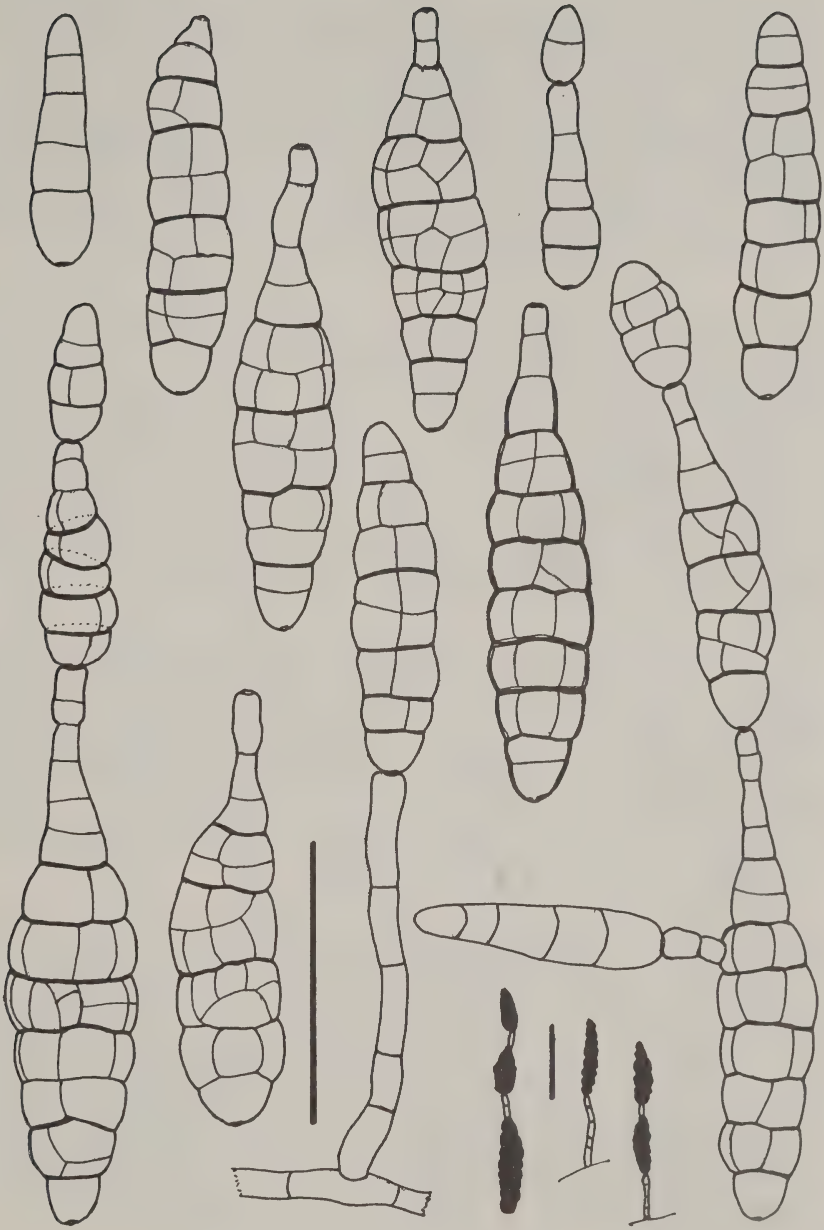

Fig. 216. *Alternaria ellipsoidea* conidia, conidiophores, and sporulation habit: ex holotype (EGS 49-104). Bars = 50μm.

x 4-5µm; transepta densa, fusca, juxta posita in spatiis ca. 5-10µm. Conidia 3-4-catenulata, ovoidea, ca. 20-40 x 11-12µm, 6-7 transeptata, unilongiseptata in 1-5 segmentis transversis; etiam conidia numerosa ovoidea, ca. 8-18 x 5-10µm, 1-2 transeptata, 0-1 longiseptata; aureobrunnea, laevia. Habitatio in foliis caulibusque Gypsophila paniculata L., Kenthurst, New South Wales, Australia. Typus: partes ex cultura EGS 44-015 (ex ***DAR*** *43414, lect. J. Dominello, 11.v.1983), desiccatae et in* ***BPI*** *841367 (holotypus) et saltem in* ***IMI*** *(isotypus) conservandae.*

A leaf and stem blight of horticultural *Gypsophila paniculata* L. ("baby's breath") in New South Wales, Australia, in 1983 yielded isolates of an *Alternaria* that is noteworthy more for the bizarre (for *Alternaria*) nature of its hyphal septation than it is for the morphology of its conidia. The walls and septa of conidia and of all conidiogenous hyphae are strong in both thickness and color without being embellisioid, and are more closely positioned than has been found elsewhere in the genus. Although the conidia and their sporulation pattern are distinctive, it is the close-set pattern of cross septa in unusually sturdy conidiophores that immediately catches the eye.

Vegetative hyphal growth of *A. juxtiseptata* is distinctly radial and almost entirely within or on the surface of PCA and V-8 agar substrates. Additionally, on Hay agar the submerged radial growth is multiply and delicately short branched, giving the appearance of a fine, soft flask brush. A minor element of a few very long, arching, aerial hyphae has the 50X look of fine black wire; scattered along the length of these hyphae are very short conidiophore branches bearing very short chains of conidia.

Primary conidiophores arise in large but not crowded numbers directly from radial surface hyphae. Many such conidiophores are solitary, but they also occur as frequently in small branching clumps. They are dark, almost rigid, ca. 50-110 x 4-5µm, and are closely transeptate at intervals of ca. 5-10µm. This coarsely septate condition, which is repeated in the abundant long secondary conidiophores, is at present diagnostic for the taxon. The unusual close-septate character present in elements of *A. juxtiseptata* is one often associated with dematiaceous growth seen on the surfaces of dry herbaceous stems. I think that we can expect to find other taxa with this closely septate character.

Sporulation of *A. juxtiseptata* is in short chains of 3-4 conidia and in branching clumps of up to ca. 10 conidia. Conidia are relatively small and unexceptional in shape and number of septa. However, they become distinctly remarkable in their pattern of chain formation. Any conidium may generate a secondary spore from an apical or lateral cell that is scarcely differentiated morphologically into a conidiogenous site. Such secondary conidiophores are slightly paler than and no more than 0-3μm in height beyond the conidium body cell that produced it. Alternatively, conidia frequently produce a strong, dark, closely septate secondary conidiophore with the same stiff and coarse appearance found in primary conidiophores and in many vegetative hyphae.

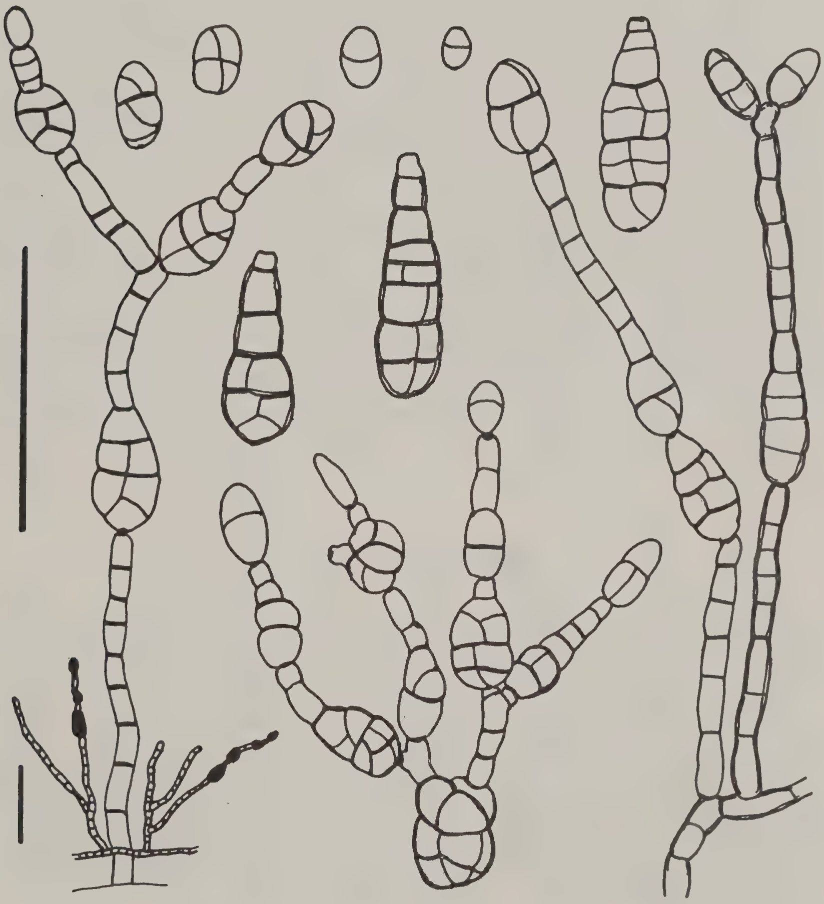

Fig. 217. *Alternaria juxtiseptata* conidia, conidiophores, and sporulation habit: ex holotype (EGS 44-015). Bars = 50μm.

Largest conidia are ovoid, reach a size range of ca. 20-40 x 11-12µm, and have up to 6-7 transepta and a single longiseptum in 1-5 of the transverse segments. However, conidia also occur in large numbers as ovoid units only 8-18 x 5-10µm, with 1-2 transepta and 0-1 longiseptum in some of the transverse segments. Conidium outer walls and most of the septa are relatively thick and gold-brown. Conidia appear to be quite smooth.

304. **Alternaria subelliptica** E. G. Simmons, sp. nov.

Fig. 218

Conidia solitaria vel bicatenulata, ellipsoidea, ca. 45-65 x 8-10µm, vel anguste ovoidea, ca. 45-55 x 9-12µm; erostrata vel minime secundarie rostrata ad 3-6 x 3µm; 5-10 transverse septate, 1-2 longiseptata in 4-5 segmentis transversis; dilute luteobrunnea, laevia. Habitatio typi in

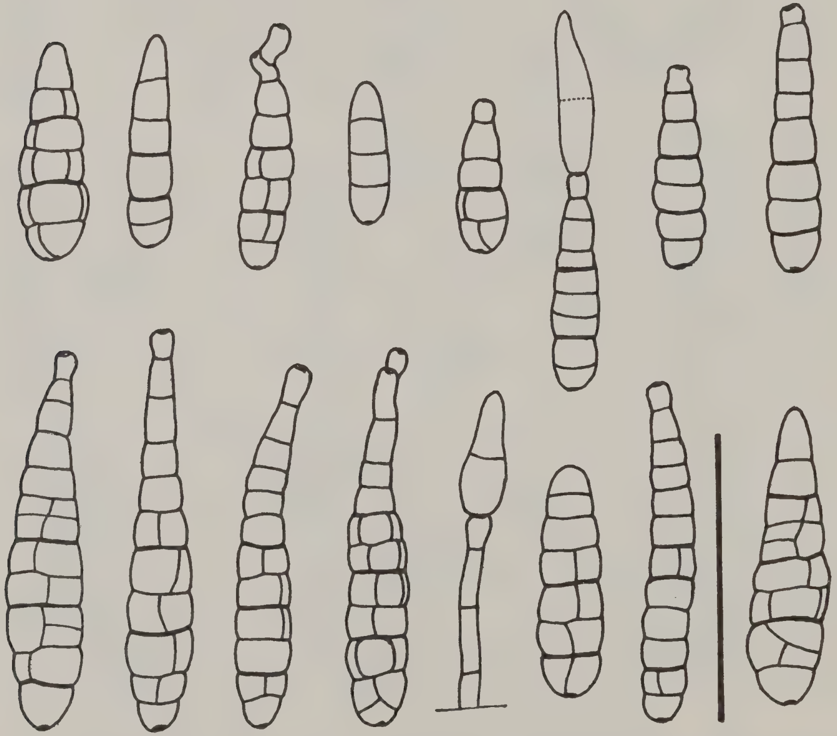

Fig. 218. *Alternaria subelliptica* conidia and conidiophores: ex holotype (EGS 49-132). Bar = 50µm.

*Gypsophila paniculata L., Reynosa, Mexico, xii.1969. Holotypus **BPI 446291** (EGS 49-132).*

Recent search of *Alternaria* collections on caryophyllaceous substrates held in the U. S. National Fungus Collections (BPI) yielded supporting material for several of the opinions given above. At least one of the BPI collections on *Gypsophila paniculata* could not be identified with any of the host-related taxa discussed previously. Although conidia of *A. subelliptica* have a general long-ellipsoid appearance similar to that seen in some conidia of a few of the other species discussed here, their maximum dimensions fall well below those of the other taxa.

Conidia of *A. subelliptica* apparently occur in short chains in nature, in that about half of the conidia in the sample examined have an apical one-celled secondary conidiophore. Juvenile conidia are long-ellipsoid or narrowly ovoid and ca. 27-29 x 5-6µm when the first 1-3 transverse septa appear. More fully developed conidia retain the narrowly ellipsoid or ovoid morphology, are ca. 45-65 x 8-10µm (ellipsoid) or ca. 45-55 x 9-12µm (ovoid). The apical secondary conidiophore cell is at most 3-6 x 3µm; otherwise, the conidia are totally erostrate. The conidium body has 5-10 transepta and 1-2 longitudinal and oblique septa in as many as 4-5 of the transverse segments. The conidium body is a dilute yellowish brown and appears to be without surface ornamentation.

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It is my continuing pleasure to be able to acknowledge the generous attention of colleagues Mary E. Palm Hernández and Rodney G. Roberts to their presubmission reviews of this material. Overly obscure points never get past them.

The support of individuals who have shared specimens and cultures are acknowledged in pertinent places in the text, as are institutions that have permitted examination of their herbarium holdings. Little of this *Alt.T&V* effort would be possible without such help.

KEY TO ALTERNARIA SPECIES DESCRIBED FROM CARYOPHYLLACEAE

{Con. = conidium/-a; (*Alt.T&V* no.)}
{* = not known in culture}

1. Con. length high range to 65µm 2
1. Con. length high range 65+µm 3

2. Con. elliptic, up to 45-65 x 8-10µm . . . ***subelliptica** (304)
2. Con. ovoid, up to 20-40 x 11-12µm,
conidiophores closely septate . . . . **juxtiseptata** (303)

3. Con. 20-40 in large clumps . . . . **nobilis** (288)
3. Con. in short straight or branched chains 4

4. Con. narrow, to 80-125 x 11-18µm . . . . **dianthicola** (299)
4. Con. becoming broader than 20µm 5

5. Con. body commonly longer than 100µm 6
5. Con. body not longer than 100µm 7

6. Con. body length (field) to 90-110(-130)µm,
to 80-160µm in culture. . . . . **saponariae** (287)
6. Con. body length (field) to 90-160(-176)µm .***longispora** (294)

7. Con. body strongly ellipsoid,
to 65-90 x 16-23µm . . . . **ellipsoidea** (302)
7. Con. body narrowly to broadly ovoid 8

8. Con. narrow-ovoid (field & culture); well-
developed secondary conidiophore
in culture . . . . **vaccariae** (297)
8. Con. broad-ovoid, (field) apex
often rounded . . . . ***gypsophilae** (300)

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NOTES ON HYPHOMYCETES. LXXXVI. SOME ADDITIONAL HAPLOTRICHUM SPECIES, WITH SUPPLEMENTARY COMMENTS ON, AND A KEY TO, THE GENUS

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ABSTRACT

Fourteen additional species of *Haplotrichum* are described and illustrated, bringing the number treated by the authors to twenty-nine. An account of the respective distinguishing characteristics of each is presented. They include five taxa which are being transferred into the genus, and one novel species. In accordance with a genus-for-genus philosophy, *Allescheriella* is considered a synonym. Further commentary is made on the considerable morphological variation existing within the genus and among individual species of apparently close phylogenetic affinity. A revised treatment of *H. curtisii* is provided in order to more adequately document the apparent phenotypic plasticity of this entity. A nomenclatorial addendum to fully list *H. capitatum* synonymies is included, and a key to all thirty-two species known is furnished.

KEYWORDS: *Allescheriella*, *Botryobasidium* anamorphs, *Oidium*, species concepts.

INTRODUCTION

As a further contribution to our knowledge of the genus *Haplotrichum* Link : Fries, an additional fourteen species are described and illustrated herein. Together with the fifteen taxa previously treated (Partridge *et al.*, 2001a; 2001c), this almost completes the task of redescription of the known species of this genus. Among those considered in this publication are several newly classified in *Haplotrichum*, all but two of which were previously, at one time or other, placed in *Oidium* Link, as typified by *O. aureum* (Pers.) Link. Included is the anamorph presently known as *Allescheriella crocea* (Mont.) S. Hughes [= *A. uredinoides* Henn.], the type species of *Allescheriella* Henn. This taxon was accepted in *Oidium* [as *O. simile* Berk.] by Linder (1942), together with many of those now placed in *Haplotrichum*, but Hughes (1953), referring to it as an "odd species", considered it best maintained separately in its own genus. This latter position was subsequently adopted by Lentz (1967), Holubová-Jechová (1969), Ellis (1971), and Langer (1994). However, in light of the fact that this entity is known to be an anamorph of *Botryobasidium* Donk, its teleomorph being *B. croceum* Lentz (Lentz, loc. cit.), and given the considerable morphological variation, but yet a continuum, existing within *Haplotrichum* as presently circumscribed, there can be little doubt of the appropriateness of its placement in this mitosporic form-genus. In all essential characteristics, apart from the considerable thickness of its conidial wall, *A. crocea* fits comfortably and well within *Haplotrichum*. By its classification therein, moreover, a genus-for-genus taxonomic condition is brought about, thus nullifying what is, in essence, a phylogenetically discordant generic concept. Also included in *Haplotrichum* is the anamorph of *Botryobasidium ponderosum* M.J. Larsen. Although this was briefly described as part of the characterization of its teleomorph by Larsen *et al.* (1996), and designated as a *Haplotrichum*, no independent binomial was given to it. In order to achieve uniform taxonomic treatment and follow accepted practice [see Holubová-Jechová (loc. cit.)], a separate name is established for it herein.

In addition to the twenty-nine species treated in this series of publications, several further taxa that belong in *Haplotrichum* are known to exist, as well as one or two other entities which very probably should also be classified in this genus. The anamorphs of two species of *Botryobasidium*, namely *B. latisporum* (Maekawa) G. Langer [= *B. candicans* J. Erikss. var. *latispora* Maekawa] and *B. longisporum* G. Langer, have been reported (Langer, loc. cit.; Langer and Langer, 1998) but no binomials in *Haplotrichum* have, to date, been published for them, nor have they been fully described and illustrated. These are not treated herein since the present authors have not, to date, had opportunity to examine them.

A further species, *H. perseae* R.F. Castañeda, was relatively recently described from Cuba (Castañeda Ruíz, 1996), and judging from the original description and illustration of *Rhinotrichum mexicanum* Guzmán (Guzmán, 1982) we have little doubt that it, also, is a species of *Haplotrichum*. By classifying the latter in *Rhinotrichum* Corda, Guzmán (loc. cit.) adopted a generic name of uncertain application [see Hughes (1958)]. Of the species of *Haplotrichum*, including some of the taxa transferred to the genus in this publication, *R. mexicanum* bears some resemblance to several. In conidium shape and size it comes close to *H. sphaerosporum* (Linder) Hol.-Jech. and *Oidium laevisporum* (Cooke) Linder [which is transferred into *Haplotrichum* below], but, judging from its original description, *R. mexicanum* appears to differ from these taxa in certain other characteristics, including conidium wall thickness, presence of surface ornamentation, and conidiophore morphology. Guzmán (loc. cit.) considered *R. mexicanum* to be close to *Stenocephalopsis subalutaceum* (Peck) Chamuris & C.J.K. Wang [as *Rhinotrichum subalutaceum* Peck], but it is evident that there are substantial differences between the two. He noted also that *R. mexicanum* is close to *Haplotrichum curtisii* [as *Rhinotrichum subferruginosum* Sumst.] in color of mycelium and tropical habitat. Until an examination of its type specimen is conducted, some uncertainty must remain as to its taxonomic status, particularly whether or not it represents a separate species other than one of those considered in this series of publications. Judging from the characteristics documented in the original description of *R. mexicanum*, it seems possible that this name may be based on a form of *H. curtisii*.

Examination of additional collections of *Haplotrichum curtisii* (Berk.) Hol.-Jech. has led to a realization that this taxon, the anamorph of *Botryobasidium curtisii* Hallenb., is highly variable with regard to both conidiophore morphology and conidial size. Partridge *et al.* (2001c) considered a collection made in Florida by Roland Thaxter, and identified by Dr. David H. Linder as *Rhinotrichum curtisii* (Berk.) Berk., to be readily distinguishable from this species, but study of further specimens has led the present authors to believe that what at first appeared as a distinct form in fact represents a condition which falls within a range of morphological expressions. This has been determined to be the case since intermediate forms have been encountered during the course of more recent studies. An amended description and further illustration of this species is provided in order to give full account of this variation and to document the distinctions between *H. curtisii* and *Oidium laevisporum*, a taxon which Holubová-Jechová (1969) considered conspecific with the former but which, as indicated above, is accepted as a separate entity herein.

A key to the twenty-nine species described by the present authors (Partridge *et al.*, 2001a; 2001c; and this paper), together with the two anamorphs reported by Langer (loc. cit.) and Langer and Langer (loc. cit.), as well as the taxon described by Castañeda Ruíz (loc. cit.), is provided. Also included, for comparative purposes, is the anamorph named *Parahaplotrichum idahoense* W.A. Baker & Partridge.

TAXONOMIC PART*

Haplotrichum armeniacum (Berk. & M.A. Curtis) Partridge & Morgan-Jones, comb. nov. (Figures 1 & 2).

≡ *Rhinotrichum armeniacum* Berk. & M.A. Curtis, *Grevillea* 3:108, 1875.

= *Zygodesmus effusus* Berk. & M.A. Curtis, *Grevillea* 3:145, 1875.

≡ *Oidium effusum* (Berk. & M.A. Curtis) Linder, *Lloydia* 5:199, 1942.

Teleomorph: unknown.

Colonies effuse, dense, hypochnoid, at first chamois to buff-colored, becoming yellow-ochre, eventually having an orange hue. Mycelium mostly superficial, composed of repent, branched, septate, loosely interweaving, occasionally anastomosing, smooth, hyaline, 3.5 to 6 µm wide hyphae, which bear clamp connections. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight or somewhat flexuous, or moderately bent, particularly in the distal portion, infrequently branched, occasionally anastomosing, smooth or minutely verruculose, especially in the upper reaches, cylindrical, septate, with clamp connections but not invariably fibulate, relatively thin-walled, usually bearing numerous, cylindrical, irregularly-shaped, simple or shortly-branched, up to 6 µm long, conidiogenous denticles, which are predominantly concentrated in the sub-apical cell with a few in adjacent cells but none in the basal portion, hyaline to pale yellowish, usually up to 300 µm long, 5.5 to 7 µm wide. Conidiogenous cells polyblastic, integrated, determinate, terminal or intercalary, where apical usually bearing a few denticles and sterile at the extreme tip. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, smooth, thick-walled, globose, pale yellowish, 10 to 17 µm in diameter.

*[Note: nomenclatural and taxonomic synonyms according to Linder (loc. cit.), Hughes (1951; 1958), and/or the present authors, unless otherwise noted.]

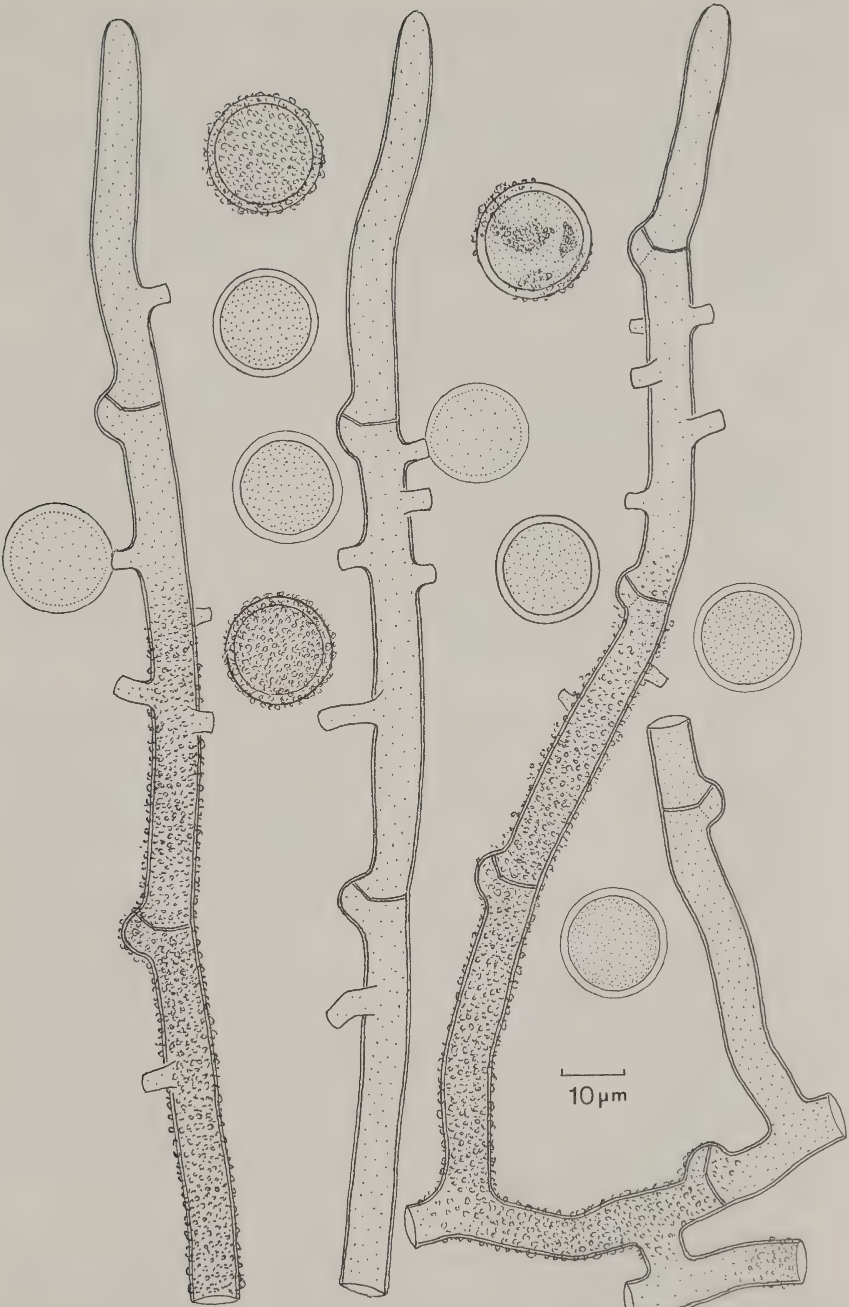

FIGURE 1. *Haplotrichum armeniacum* [type of *Rhinotrichum armeniacum*]. Conidiophores and conidia.

On dead wood and decaying polyporaceous fruit bodies; North America.

Specimens examined: South Carolina, USA, H.W. Ravenel, in Herb. Berkeley, 2598, undated, K, type of *Zygodesmus effusus*; Gainesville, Florida, USA, W.A. Murrill, 27 March 1938, F-16127, FH; on old basidiocarp of *Phaeolus schweinitzii* (Fr.:Fr.) Pat. [as *Polyporus schweinitzii* Fr.:Fr.], Santee Canal, South Carolina, USA, H.W. Ravenel (1086), summer 1849, FH, type of *Rhinotrichum armeniacum*.

Linder (loc. cit.) considered the specimen on which the name *Rhinotrichum armeniacum* is based to be uniquely different from all other taxa included by him in *Oidium* because of, to quote, "its incrusted globose conidia, its heavily incrusted conidiophores, and by the presence of clamp connections at the septa". In the original description of this taxon, Berkeley (1875) had mentioned the "granulated" nature of this anamorph, and subsequently Sumstine (1911), who also examined the type material, described the conidiophores as being spinulose and the conidia as being granular. Linder (loc. cit.), furthermore, noted the impermanence of what he referred to as crystalline incrustations when mounted in lactophenol.

Examination of the type specimen by the present authors has confirmed the abundant presence of what appear to be superficial crystalline deposits on the surface of hyphae, conidiophores, and conidia. Moreover, the same observation as that made by Linder (loc. cit.) vis-à-vis the evanescent nature of these incrustations has been made. Conidiophores and conidia lacking such embellishment, as well as some which are heavily or partially covered with deposits are present [see Figure 1]. Detection, however, of similar deposits on the surface of what is thought to be a thick-walled, dematiaceous Hyphomycete conidiophore remnant on the same substrate, and on some of the decaying remains of the host basidiocarp itself, has called into question whether or not the incrustations are artifactitious in nature. Because of the depauperate and deteriorated condition of the material, it is difficult to determine or speculate as to the origin of the surface deposits, but we remain unconvinced that they are a true part of this anamorph. A final determination in this regard must probably await the collection of additional specimens showing the same characteristic.

Holubová-Jechová (1969) listed *Oidium effusum* as a facultative synonym of *H. armeniacum* [as *Oidium armeniacum*] and we are in agreement with this determination as to their conspecificity. Although this author apparently examined the type specimen of *H. armeniacum*, she did

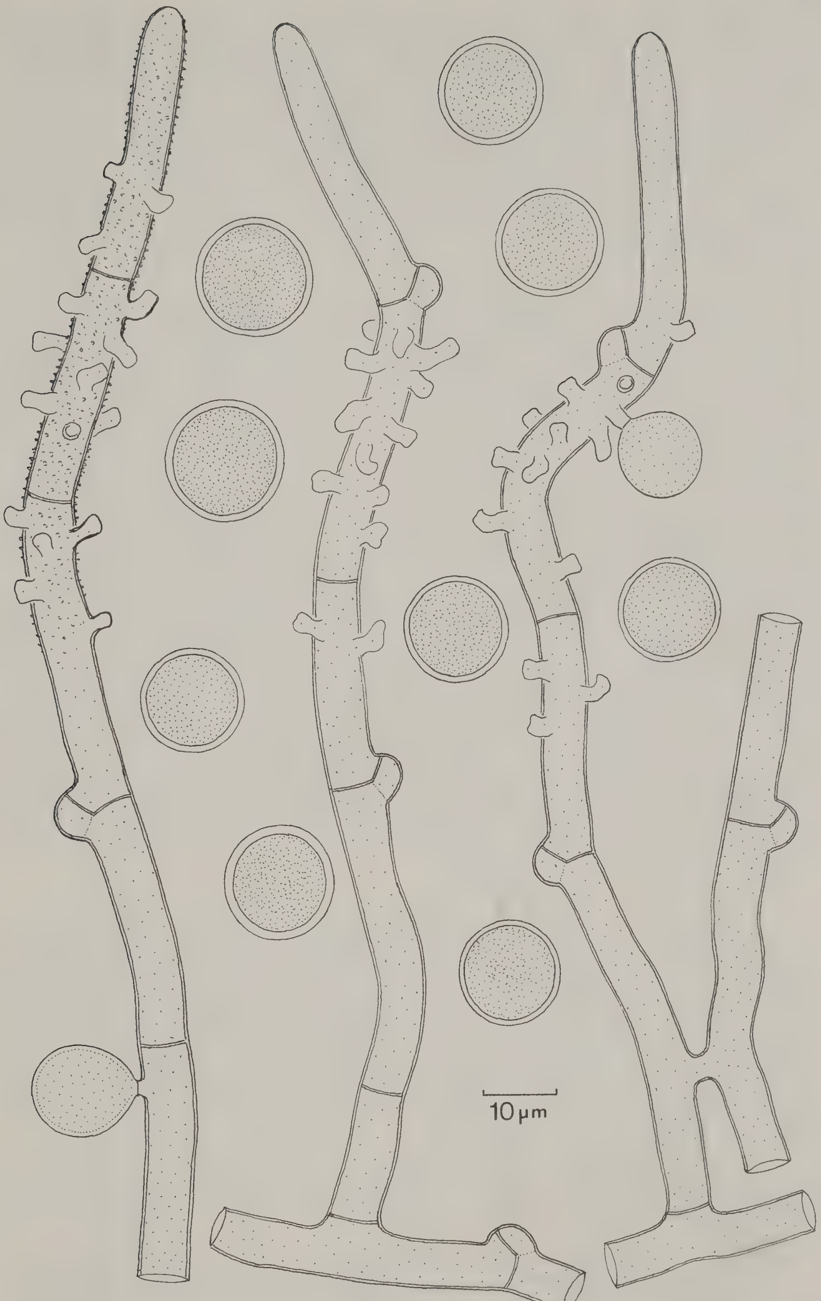

FIGURE 2. *Haplotrichum armeniacum* [type of *Zygodesmus effusus*]. Conidiophores and conidia.

not, however, reclassify this taxon within *Haplotrichum* in her publication (Holubová-Jechová, 1976) in which nomenclatural transfers of twenty species of *Oidium* were made. The reason for this is not immediately apparent, since *H. armeniacum* clearly fits comfortably in *Haplotrichum* and, as Linder (loc. cit.) pointed out in his treatment of *O. effusum*, has something of the aspect of *H. conspersum* (Link) Hol.-Jech. from which it differs in coloration, conidium shape and wall thickness, and denticle peculiarities, as well as by having fibulate septa.

Our examination of *Zygodesmus effusus* confirms, as noted above, that it is the same entity as *H. armeniacum*, although small differences can be detected in the respective type specimens on which these two binomials are based. Apart from the absence of surface incrustations in the former, its conidiophores differ in being somewhat more flexuous and more heavily denticulate. Moreover, the conidia in the type collection of *H. armeniacum* are mostly of a smaller diameter [11 to 13 µm] than those of *Z. effusus* [13 to 16 µm]. Interestingly, however, the conidia in a third collection of what is undoubtedly the same species [made by W.A. Murrill (see above)] have a broader size range [10 to 17 µm]. These observations indicate some variability, which is also reflected in the presence or absence of minutely verruculose conidiophore wall ornamentation. This latter feature, it should be emphasized, is entirely different in kind from the superficial incrustations present in the type of *H. armeniacum*. Linder (loc. cit.) noted the occasional presence of conidia in fragile, short chains in *O. effusum* and in short chains (qualified by a '?') in *O. armeniacum*. The present authors are unable to confirm this characteristic. In the specimens examined, no evidence of conidial catenation was observed.

Haplotrichum armeniacum can be distinguished from other species of the genus having similarly-shaped conidia, such as *H. curtisii* (Berk.) Hol.-Jech., *H. rubiginosum* (Fr.) Hol.-Jech., *H. tenerum* (Sumst.) Hol.-Jech., and a few others, by a number of characteristics. Conidiophores with sterile apices bearing prominent, irregularly-shaped denticles, mostly localized on the subterminal cell, and presence of clamp connections, are particularly distinctive features of this taxon.

Haplotrichum caribense (Hol.-Jech.) Hol.-Jech., *Česká Mykol.* 30:3, 1976 (Figure 3).

≡ *Oidium caribense* Hol.-Jech., *Česká Mykol.* 23:218, 1969.

Teleomorph: unknown.

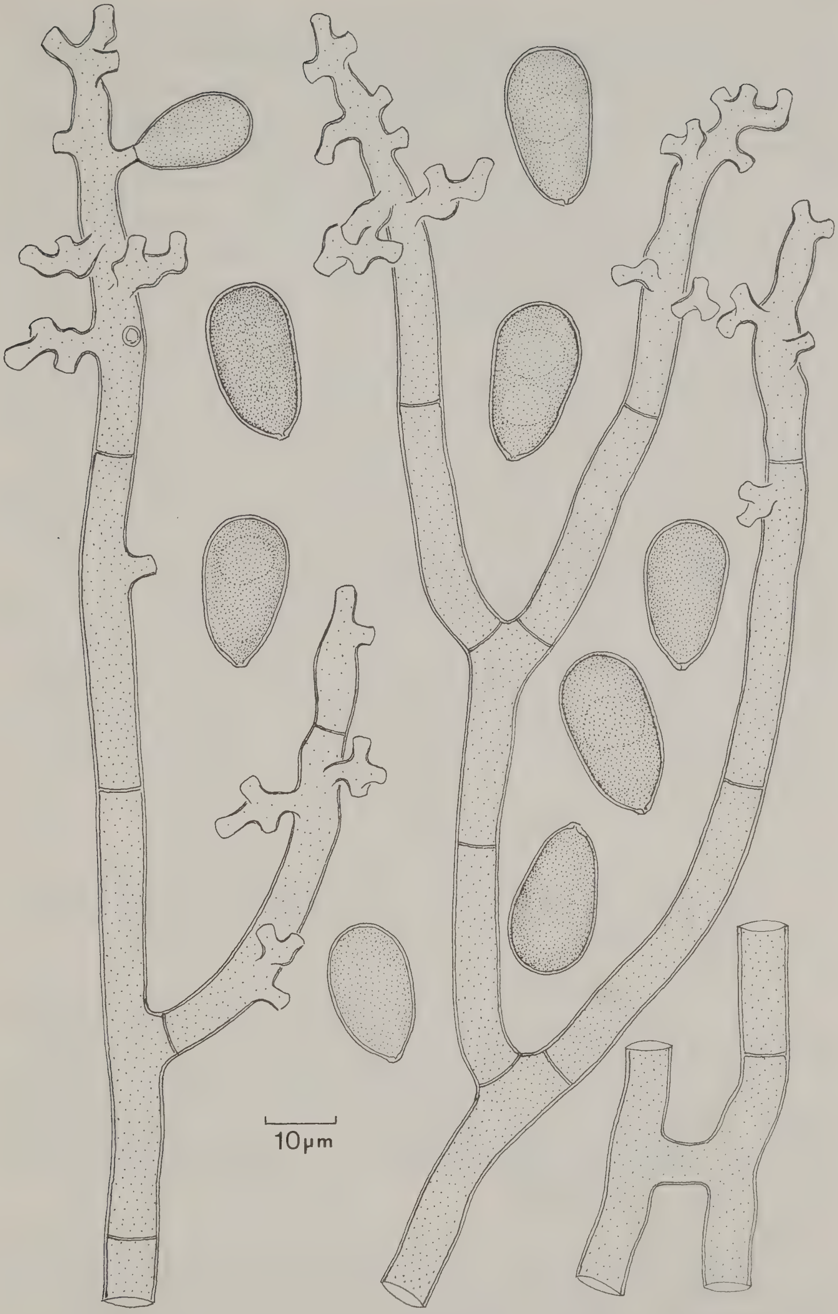

FIGURE 3. *Haplotrichum caribense*. Conidiophores and conidia.

Colonies initially discrete, more or less orbicular, becoming widely effuse, confluent, and somewhat irregular in shape and extent, hypochnoid, dense and, with maturity, velvety, pale to dark rusty brown in color. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, mostly prostrate, smooth, hyaline to pale-yellowish, 3 to 7 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight to somewhat flexuous or arcuate, cylindrical, often branching at fairly wide angles, branches curving to ascend parallel to the main stipe, sometimes anastomosing, smooth, septate, moderately thick-walled, denticulate primarily in the terminal cell and occasionally in the sub-terminal cell, sub-hyaline to pale brown, generally up to 400 µm long, sometimes up to 600 µm long, 7 to 10 µm wide, tapering distally to 2 µm wide. Conidiogenous cells polyblastic, integrated, cylindrical, sometimes tapering distally, determinate, bearing well-developed, gregarious denticles, which may branch often and closely, giving a contorted, dendritic aspect; generally up to 60 µm long, denticles 2 to 4 µm wide, 3 to 6 µm long where simple, or up to 15 µm long where extensively branched. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, smooth, becoming thicker-walled than the conidiophores, with the inner wall layer often appearing irregularly stratified and unevenly roughened, ellipsoid to obovate to broadly clavate, sometimes very slightly narrower in the middle part, broadly obtuse at the apex, bearing a slightly-projecting, truncate basal papilla of varying width, mid brown, often with one or two large guttules, 16-24 × 9-14 µm in size.

On dead wood of *Pinus tropicalis* Morelet; Caribbean.

Specimen examined: savannah in El Colong, near Siguanea, Isla de Pinos, Cuba, F. Kotlaba, 19 February 1967, PR 670954, holotype.

This species was classified by Holubová-Jechová (1980) in her section *Avesiculata*, subsection *Ellipsoidea*, which is typified by *H. conspersum* (Link) Hol.-Jech., and also includes *H. ellipsosporum* (Hol.-Jech.) Hol.-Jech. and *H. magnisporum* (Linder) Hol.-Jech. It should be noted, however, that although the respective conidiophores of the latter three taxa are similar, those of *H. caribense* are strikingly different, especially with regard to the peculiarities of the denticles.

In the appearance of its colonies, particularly coloration, and the thick-walled nature of its conidia, Holubová-Jechová (1969) considered *H. caribense* to be suggestive of *Allescheriella crocea*. There are, however, considerable differences between the two, even in conidial wall thickness, which is appreciably greater in *A. crocea* [see below]. *Haplotrichum caribense* was also (Holubová-Jechová, 1969) compared with *H. rubiginosum* [as *Oidium rubiginosum* (Fr.) Linder] in color and conidiophore wall thickness, but these taxa are quite different in other regards [see Partridge *et al.*, 2001c]. By possession of a stratified inner conidial wall, *H. caribense* bears resemblance to several species, including *H. curtisii*, *H. rubiginosum*, and *H. tomentosum* (Berk. & M.A. Curtis) Hol.-Jech. Among species of *Haplotrichum*, *H. caribense* is readily distinguishable by a combination of the unique nature of its conidiogenous denticles and conidium shape and coloration.

Haplotrichum croceum (Mont.) Partridge & Morgan-Jones, comb. nov. (Figure 4).

≡ *Mucor croceus* Mont., Hist. Phys., Pol. Nat. Cuba, p. 307, 1842.

≡ *Gymnosporium croceum* (Mont.) Berk. & M.A. Curtis, *J. Linn. Soc. London, Bot.* 10:355, 1869.

≡ *Chromosporium croceum* (Mont.) Sacc., *Sylloge Fungorum* 4:7, 1886.

≡ *Allescheriella crocea* (Mont.) S. Hughes in Baker and Dale, *Mycol. Pap.* 33:97, 1951.

= *Gymnosporium fulvum* Berk. & M.A. Curtis, *J. Linn. Soc. London, Bot.* 10:355, 1869.

≡ *Chromosporium fulvum* (Berk. & M.A. Curtis) Sacc., *Sylloge Fungorum* 4:6, 1886.

≡ *Coniosporium fulvum* (Berk. & M.A. Curtis) Pound & Clem., *Minn. Bot. Stud.* 9:660, 1896.

= *Rhinotrichum fulvum* Berk. & M.A. Curtis, in Berk., *Grevillea* 3:108, 1875.

= *Allescheriella uredinoides* Henn., *Hedwigia* 36:244, 1897.

= *Botrytis coccotrichoidea* Sacc. & Trotter, in Bres. and Sacc., *Bull. Soc. R. Bot. Belg.* 38:165, 1899.

= *Hyphoderma zeylanica* Petch, *Ann. R. Bot. Gardens*, *Peradeniya* 6:349, 1917.

= *Coccospora sinensis* Teng, *Sinensia* 7:782, 1936.[†]

Teleomorph: *Botryobasidium croceum* Lentz, *Mycopathol. Mycol. Appl.* 32:6, 1967.

Colonies compact, pulvinate, more or less orbicular, occasionally becoming confluent and effuse, initially whitish, becoming ochraceous and, upon maturity, reddish-brown following conidiation, with a subiculum remaining paler. Mycelium mostly superficial, composed of branched, septate, closely interweaving, repent, frequently anastomosing, smooth, hyaline to yellowish, 5 to 8 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight or somewhat flexuous, arising densely from subicular hyphae in a caespitose manner, branched, occasionally anastomosing, smooth, septate, relatively thin-walled, cylindrical but tapering slightly distally, hyaline to very pale brown, usually up to 150 µm long, 3.5 to 5 µm wide, up to 7 µm wide at the base. Conidiogenous cells monoblastic or, more rarely, polyblastic, integrated, terminal, or occasionally intercalary, or as discrete, short, lateral branches, determinate, bearing flat, thin, truncate scars where conidia are formed laterally. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, smooth, very thick-walled, obovoid to ellipsoidal, or occasionally somewhat pyriform, arising terminally or laterally, in an irregular sequence, at first yellowish, becoming reddish-brown, often guttulate, 16-28 × 12-21 µm in size, walls up to 3 µm thick, truncate at the base which remains thin-walled, sometimes bearing a circumscissile, marginal frill following detachment.

On bark and rotting, decorticated wood; cosmopolitan, mainly subtropical or tropical.

Specimens examined: on underside of pine plank, lying on tidal banks of Christiana River, near Wilmington, Delaware, USA, ex herb. A. Commons (#2745), 15 October 1890, BPI [as *Oidium simile* Berk.]; on rotten stump, Rockport, Kansas, USA, E. Bartholomew, 13 November 1893, BPI [as *Oidium simile* Berk.].

[†] *fide* Damon and Downing (1954).

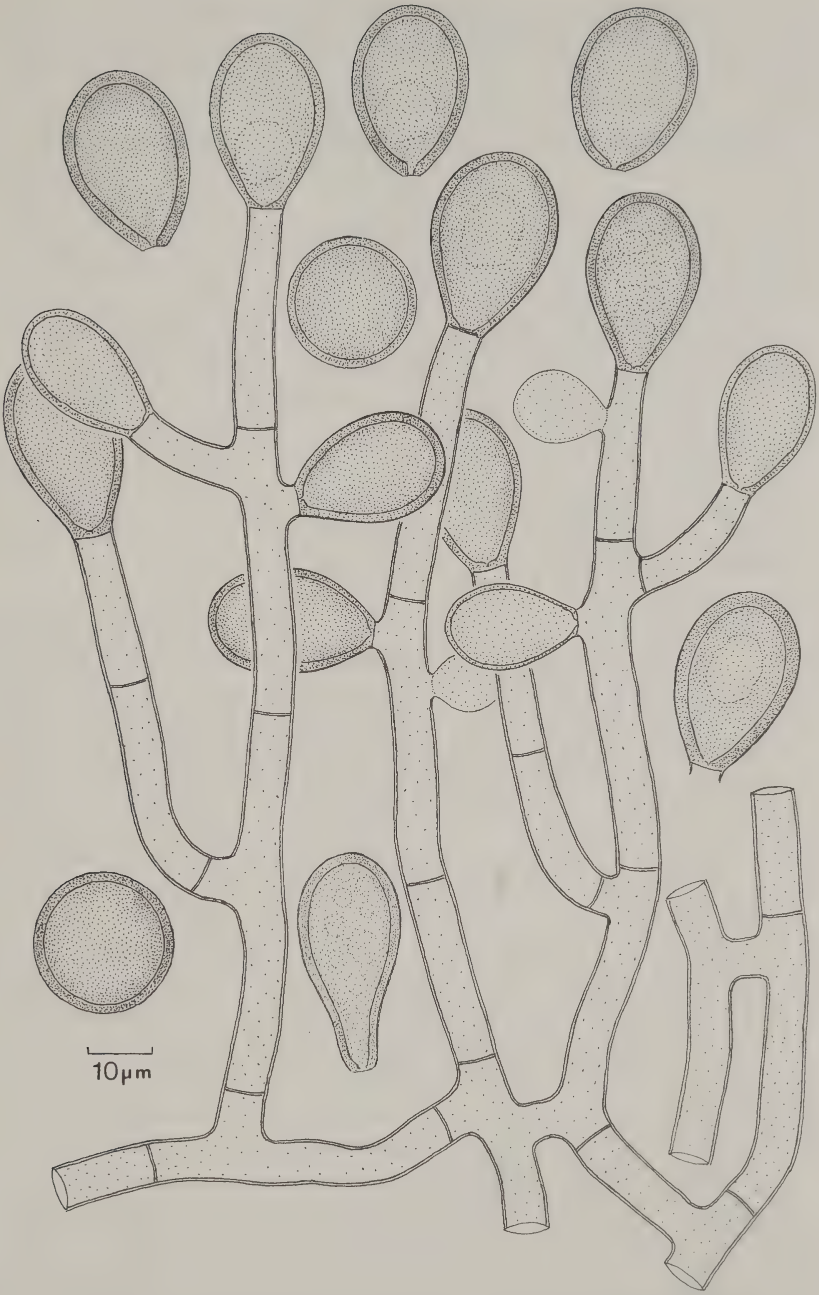

FIGURE 4. *Haplotrichum croceum*. Conidiophores and conidia.

With regard to conidium shape and the process of conidial disarticulation in *H. croceum*, there appears to be some variation. In some collections, conidia may assume an untypically long and slender aspect (Lentz, loc. cit.). Such conidia were illustrated by Hughes (1951), who commented that the final shape thereof is dependent to a large extent on the level at which a separating septum is laid down. Conidial detachment seems to be achieved in one of two ways. The conidia either disarticulate cleanly by what is assumed to be a schizolytic process, or are often released by a rhexolytic break in the conidiophore a short distance below the delimiting septum, in which case a small portion of the conidiophore tip remains attached as a frill. In this connection, it should be noted that fertile hyphae in many species of *Haplotrichum* and certain other basidiomycetous anamorph form-genera, such as *Glutinoagger* Sivan. & Watling, readily break down following conidium differentiation. Interestingly, in the type species of *Glutinoagger*, *G. fibulatus* Sivan. & Watling, where the pattern of conidiophore growth in relation to conidiogenesis is similar to that in *H. croceum*, detached conidia bear a fragmented portion of the conidiophore immediately subtending the basal septum.

As alluded to in the above introduction, by accommodating this species in *Haplotrichum* more emphasis is now being placed upon phylogenetic relatedness than has previously been the case. Although *H. croceum* differs morphologically from the majority of *Haplotrichum* species in several respects, and its classification within it admittedly somewhat compromises and broadens traditionally-held generic concepts, we believe, nevertheless, that it has sufficient similarity to justify placement in this genus. This position reverses our earlier-expressed view (Partridge *et al.*, 2001b). In reaching this taxonomic decision, the same conclusion as that of Linder (loc. cit.), who accepted this entity as a species of *Oidium*, is arrived at. In maintaining *Allescheriella* as a free-standing, monotypic genus, Hughes (1951) emphasized the absence of, in his words, "conspicuous pegs along the length of the conidiophores" and the fact that in the type species of *Oidium*, '*Oidium aureum* Link ex Fries' [a binomial misapplied to the anamorph now known as *Haplotrichum dubium* (Pers.) W.A. Baker & Partridge (a different entity from *Sporotrichum aureum* Link, the type species of *Sporotrichum* Link, and the anamorph of *Cerisporiopsis aneirina* (Sommerf.) Domański)], conidia are more or less thin-walled and borne in acropetal chains. Although Hughes (1953) entertained the notion that *H. croceum* [as *A. crocea*] might well have affinity with the Basidiomycetes, because of the development of thick-walled conidia on lateral branches and not denticles it was placed in Section III of his experimental classification of Hyphomycetes, whereas the anamorphs now known as *Haplotrichum capitatum* (Link) Link, *H. conspersum* (Link)

Hol.-Jech., and *H. dubium* were placed in his Section IB. Given the fact that all four of these are now known to have *Botryobasidium* teleomorphs and in light of the current trend towards the recognition of monophyletic genera, there can be little doubt about the desirability of accommodating these within the same anamorph form-genus, despite the presence of some morphological disparity between the various entities.

In this context it can be said that if traditional Hyphomycete generic concepts were to be applied within this complex, a number of segregate genera could well be established, for the range of morphological heterogeneity is considerable but yet, as mentioned previously, a certain continuum exists among and between individual species. With regard to further justification for inclusion of *H. croceum* in *Haplotrichum*, it should be noted that the conidiophores of such species as *H. album* (Sumst.) Hol.-Jech., *H. chilense* (Linder) Hol.-Jech., and *H. tomentosum* (Berk. & M.A. Curtis) Hol.-Jech. bear no distinct denticles, the conidiogenous loci being marked by only very slight, shallow protuberances. Similarly, in the case of conidium wall thickness, a gradation can be found among different species, from a relatively thin-walled condition, as seen in *H. medium* (Hol.-Jech.) Hol.-Jech. and the *Haplotrichum* anamorph of *Botryobasidium ponderosum* [described as a new species herein], to a moderate wall thickness present in most species, and culminating in the climax form exemplified by *H. croceum*, *H. perseae* (Castañeda Ruíz, 1996) [a species which we have not had the opportunity to examine], and *Oidium pulveraceum* (Ellis) Linder [a species which is transferred to *Haplotrichum* in the present publication].

As mentioned elsewhere (Partridge *et al.*, 2001c), Linder (loc. cit.) misapplied the binomial *Oidium simile* Berk. [the basionym of *Haplotrichum simile* (Berk.) Hol.-Jech.] to *H. croceum*, describing the anamorph on which the former is based under the name *Oidium aureo-fulvum* (Cooke & Ellis) Linder. This confusion was clarified by Hughes (1951) who provided a comprehensive nomenclator for the species. Damon and Downing (1954) added *Coccospora sinensis* Teng to its synonymy. In this connection it is interesting to note that von Höhnel (1911) considered *Allescheriella* to be a synonym of *Coccospora* Wallr., although he had reportedly not examined any specimen of *H. croceum* [as *A. uredinoides*], and this position was adopted by Clements and Shear (1931). Damon and Downing (loc. cit.), however, determined that the type species of *Coccospora*, *C. aurantiaca* Wallr., was based on a sclerotial form and the generic name is now considered to be a *nomen dubium* (Carris, 1993). In view of the action taken in this publication, the name *Allescheriella* should now be added to the nomenclator of

Haplotrichum [see Partridge *et al.*, 2001a] as a facultative synonym (= *Allescheriella* Henn., *Hedwigia* 36:244, 1897.).

Haplotrichum curtisii (Berk.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 5).

[For full nomenclator see Partridge *et al.* (2001c).]

Colonies effuse, spreading, hypochnoid, resupinate, at first thin and pale cinnamon-brown in color, becoming dense, powdery and ochre-orange when mature. Mycelium mostly superficial, assuming a subiculum-like aspect, composed of branched, septate, abundantly interweaving, occasionally anastomosing, repent, smooth, hyaline to pale ochraceous-brown, 1 to 5 µm wide hyphae. Conidiophores semi-macronematous, mononematous, at first more or less erect, becoming somewhat prostrate with the terminal elements ascending and interweaving, simple or, more often, branched, with lateral branches often oriented at a wide angle, straight to flexuous and undulate, sometimes becoming circinate or spirally coiled, cylindrical, inflated at the apex, smooth, septate, with wall of medium thickness, denticulate, hyaline to pale brown, up to 450 µm long, 7 to 11 µm wide. Conidiogenous cells polyblastic, integrated or discrete as lateral branches, terminal or intercalary, cylindrical but mostly, where terminal or lateral, and occasionally where sub-terminal, broadly clavate to obovoid, occasionally somewhat vesicle-like, determinate, denticulate, especially where apical or penultimate; denticles up to 5 µm long, generally 2 to 3 µm wide. Terminal conidiogenous cells occasionally disarticulating as conidia, especially where conidiophores are more or less straight, resulting in their becoming truncate at the distal extreme. Conidia acropleurogenous, holoblastic, solitary or bearing one or two secondary conidia, dry, unicellular, smooth, moderately thick-walled, when mature with the inner wall layer appearing minutely roughened or pitted, globose or somewhat ellipsoidal, sub-hyaline to mid brown, usually bearing a shallow papilla, where globose 9 to 16 µm in diameter, where ellipsoid 10-13 × 9-10 µm in size.

On bark and dead wood; North and South America.

Specimens examined: Coconut Grove, Florida, USA, R. Thaxter, undated, FH [accession no. 6696]; at 2300 ft. elev., Cullowhee, North Carolina, USA, R. Thaxter, June-July 1887, FH; on dead wood, Linder's Woods, Iowa City, Iowa, USA, A.M. and D.P. Rogers (955), 31 August 1936, FH; inside of loose bark, Linder's Woods, Iowa City, Iowa, USA, A.M. and D.P. Rogers (959), 31 August 1936, FH; on ground around stump of

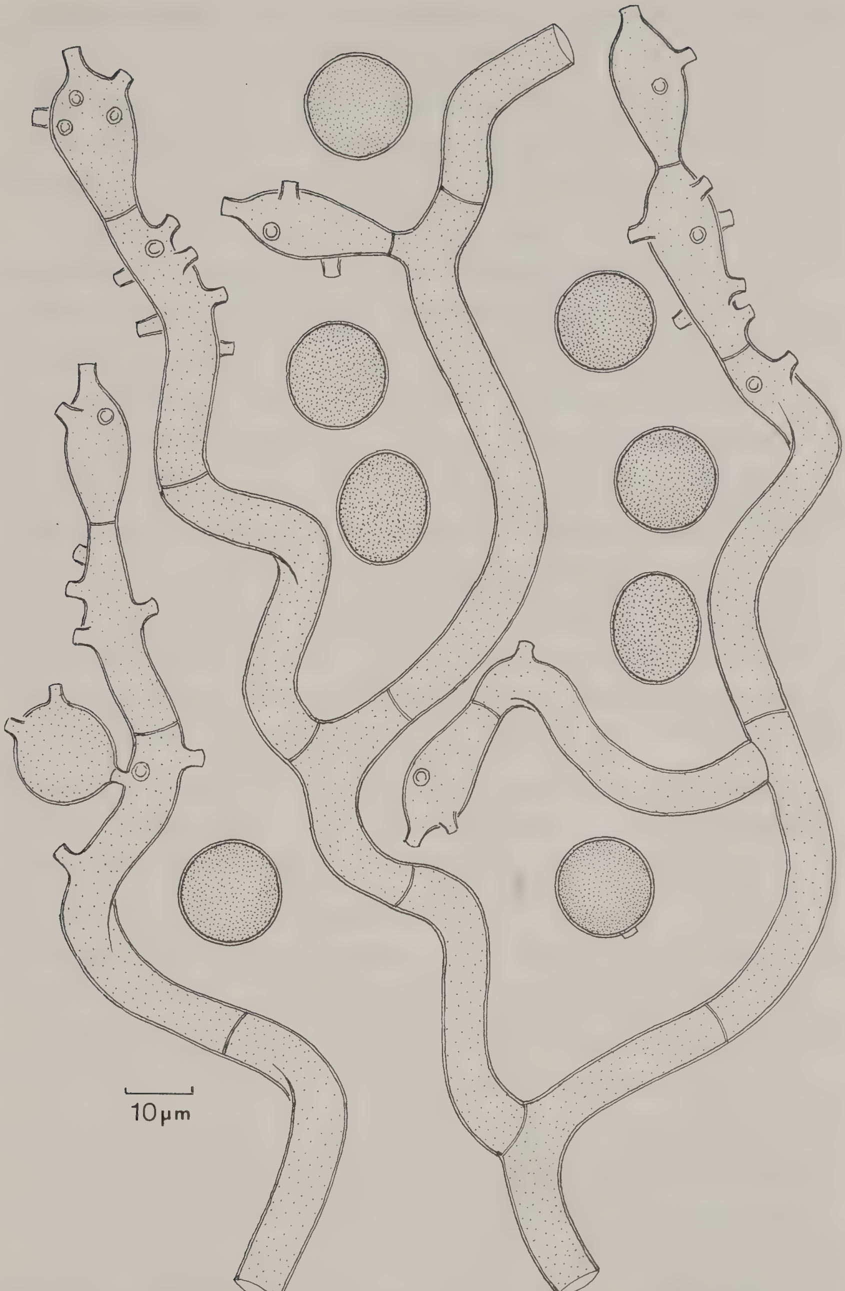

FIGURE 5. *Haplotrichum curtisii* [Thaxter, Florida collection].
Conidiophores and conidia.

Forsythia sp., Cambridge, Massachusetts, USA, D.H. Linder, 10 July 1941, FH.

As briefly discussed in a previous publication (Partridge *et al.*, 2001c), and mentioned above, the Thaxter collection from Florida, upon initial study, appeared to be closely similar to the description of *Oidium laevisporum* provided by Linder (loc. cit.) in his monographic treatment of *Oidium* Link and, moreover, to be different from *H. curtisii*. In particular, the pronouncedly undulating to spiralling nature of the conidiophores [see Figure 5] and conidial size differences indicated morphological discontinuities. There also exists some variation in conidiogenous cell shape, those typical of *H. curtisii* generally having a more vesicular aspect and, where terminal on the conidiophores, a tendency to disarticulate. This shape distinction is, interestingly, comparable to that existing between *H. curtisii* and *H. ovalisporium* (Linder) Hol.-Jech. In this connection it should be pointed out, as has been alluded to previously, that some difference in terminology application has occurred among various authors in relation to conidiogenous cells, with some referring to such as 'vesicles'. It should also be noted that some variability and intergradation in conidiogenous cell shape occurs within and between various taxa, but with usually one morphological form predominating. In a species such as *H. curtisii*, and particularly in *H. vesiculosum* (Linder) Hol.-Jech., which is considered a climax form in this regard, some conidiogenous cells are essentially ramoconidia.

As already mentioned, Holubová-Jechová (1969) considered *O. laevisporum* to be a synonym of *H. curtisii* [as *O. curtisii* (Berk.) Linder] but doubt as to their conspecificity was expressed by Partridge *et al.* (2001c). Following examination of the type material of *Zygodesmus laevisporus* Cooke [≡ *O. laevisporum*] and further consideration of the characteristics distinguishing it from *H. curtisii*, it has been determined that these two taxa differ sufficiently to be recognized as separate entities. Furthermore, it has become apparent that the specimen collected by R. Thaxter in Florida, although being similar to *O. laevisporum* in conidiophore conformation, represents a form of *H. curtisii*.

Following examination of the two collections made in Iowa, it has been determined that the conidiophores of *H. curtisii* are exceedingly variable in form, ranging from straight to spirally coiled, and some differences in conidial size also apparently exist. In one of these specimens [Rogers (959)], conidiophores are intermediate in form between the non-undulating type considered to be the more typical of this species, as described by Partridge *et al.* (2001c), and the heavily undulated condition exemplified in the Florida material. Moreover, conidium size in the Iowa collection [11 to 15 µm in diameter] overlaps that considered typical of this species [13 to 16 µm (see Langer, loc. cit. and Partridge *et al.*, 2001c)] and that found in the Florida collection [9 to 13 µm]. This size variation is comparable to that seen in *H. armeniacum* [see above]. Whether or not these divergent forms represent incipient stages in sibling speciation is a matter for speculation.

Linder (loc. cit.) made reference to two anamorph-teleomorph connections but there appears to have been some confusion and identity misdeterminations with regard to the taxa involved. In the initial commentary on the genus *Oidium*, it was reported that a "connection between the conidiophores of *Oidium curtisii* (Berk.) Linder and *O. candicans* (Sacc.) Linder with the basidia of *Botryobasidium coronatum* (Schroet.) Donk [= *Pellicularia pruinata* (Bres.) Rogers] and *B. vagum* (B. & C.) Rogers [≡ *Pellicularia vaga* (B. & C.) Rogers] respectively" had been traced. In his treatment of *Haplotrichum curtisii* [as *Oidium curtisii*], Linder (loc. cit.), however, reported a connection between it and *Pellicularia vaga* (Berk. & M.A. Curtis) D.P. Rogers [≡ *Botryobasidium vagum* (Berk. & M.A. Curtis) D.P. Rogers] having been discerned by following hyphae from conidiophores to basidia. This apparent contradiction was, presumably, brought about by an inadvertent misstatement, in the first mention, of the respective pairings. *Haplotrichum curtisii* is now known to be the anamorph of *Botryobasidium curtisii* Hallenb. (Hallenberg, 1978), and *O. candicans* [= *Haplotrichum capitatum* (Link) Link] is the anamorph of *Botryobasidium candicans* J. Erikss. Rogers (1943), Wakefield (1952), and Hughes (1953) had all reported *O. candicans* as the conidial state of *Pellicularia pruinata* and it remained for Eriksson (1958) to establish the fact that its teleomorph was a different entity. The binomial *Botryobasidium coronatum* is currently considered to be a facultative synonym of *Botryobasidium pruinatum* (Bres.) J. Erikss., which is not known to have an anamorph [see Langer (loc. cit.)]. Likewise, no mitosporic state of *Botryobasidium vagum* is presently known [ditto]. Interestingly, another binomial, *Botryobasidium botryosum* (Bres.) J. Erikss., on which Eriksson (loc. cit.) based his subgenus *Brevibasidium* J. Erikss., was, at one time, and is now [see Langer (loc. cit.)], considered to be a synonym of *B. vagum*. This was maintained as a separate entity by Eriksson (1958) [see also Talbot (1965)] on the basis of differences in basidiospore shape, the assumed existence of a *B. vagum* anamorph, and the absence of such in *B. botryosum*. The presumed anamorph was *Oidium curtisii*.

When reporting the *Oidium curtisii-Pellicularia vaga* anamorph-teleomorph connection, Linder (loc. cit.) stated that the determination in this regard was first realized following a study of the Florida specimen collected by Roland Thaxter. It was also reported that material collected in Iowa by Donald P. Rogers confirmed the relationship and a citation to this effect was also published by Rogers (loc. cit.). Eriksson and Hjortstam (1969), however, pointed out that the binomial *Botryobasidium vagum* was being used by Rogers in a very broad sense and that it comprised several distinct taxa, which in part explains the anomalies evident in the supposed anamorph-teleomorph connections. Hallenberg (loc. cit.) also raised doubts concerning this matter following examination of the Florida and Iowa specimens cited above, two additional specimens housed in the Farlow Herbarium where anamorph-teleomorph connections could be discerned, and the type material of *B. vagum*. This author also noted that the name *Botryobasidium vagum* had been used in a very wide sense, and concluded that the collections which Linder and Rogers had examined represented *B. curtisii* and not *B. vagum*. In reaching this determination, *B. vagum* was said to differ from *B. curtisii* in having sub-cylindrical to sub-allantoid basidiospores with obtuse apices, rather than the biapiculate basidiospores typical of the latter, and to have smaller basidia. In this regard, *B. vagum* was said to be close to *B. danicum* J. Erikss. & Hjortstam. In addition, Hallenberg (loc. cit.) stated that *Botryobasidium lembosporum* (D.P. Rogers) Donk is a species which is close to *B. curtisii*, differing from it by possession of shorter basidia and basidiospores with more prominent apiculi. The anamorph of the former, *Haplotrichum tomentosum* (Berk. & M.A. Curtis) Hol.-Jech. [as *H. tomentosum* (Pat.) Hol.-Jech.], was said to differ from *H. curtisii* in having looser, browner conidiophores bearing distinctly fewer sporogenous teeth. It should be pointed out, however, that *H. curtisii* and *H. tomentosum* have far more significant differences than were documented by Nils Hallenberg [see Partridge *et al.* (2001c)].

In the most recent monograph of the genus *Botryobasidium* Donk (Langer, loc. cit.), the salient characteristics of the respective species mentioned above, interestingly, seem to differ considerably from those documented by Hallenberg (loc. cit.). In particular, the basidiospores of *B. vagum* are described as being broad-navicular to navicular and biapiculate, in sharp contrast to the shape mentioned by Hallenberg. Since both these authors reportedly examined type material of this species, the description discrepancy seems unfortunate. According to Langer (loc. cit.), the difference between *B. curtisii* and *B. vagum*, among other things, lies in the former having shorter and narrower basidiospores which are navicular to subfusoid. In his discussion relating to *B. curtisii*, Hallenberg (loc. cit.) noted that it belongs to the '*B. botryosum*-group' characterized by biapiculate basidiospores and differing from *B. botryosum* only by having narrower spores. Since *B. botryosum* is now considered to be a synonym of *B. vagum*,

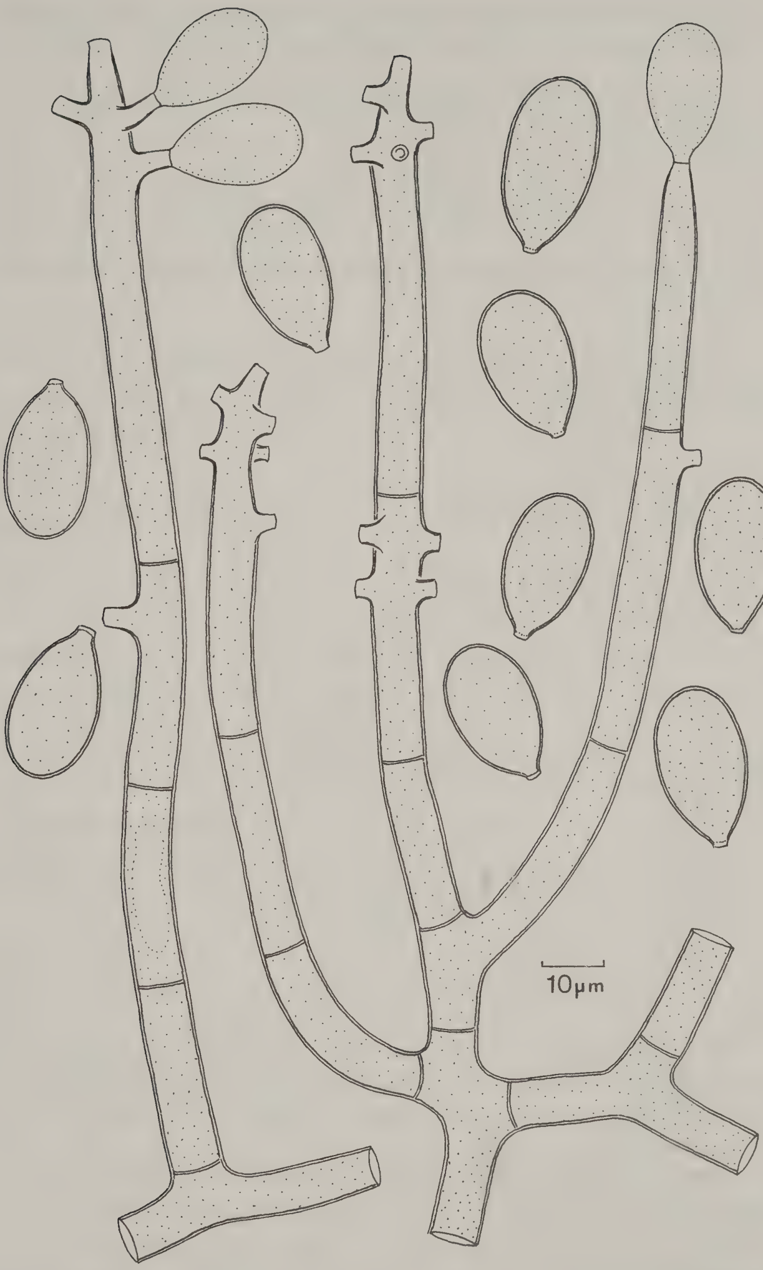

FIGURE 6. *Haplotrichum ellipsosporum*. Conidiophores and conidia.

quite clearly some confusion has existed concerning the characterization, differentiation, and delimitation of species in this teleomorph complex.

Haplotrichum ellipsosporum (Hol.-Jech.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 6).

≡ *Oidium ellipsosporum* Hol.-Jech., *Česká Mykol.* 23:211, 1969.

Teleomorph: *Botryobasidium ellipsosporum* Hol.-Jech., *Česká Mykol.* 23:211, 1969.

Colonies effuse, spreading, hypochnoid, at first thin and whitish, becoming tufted, cottony, somewhat pulvinate and yellowish to ochraceous with age. Mycelium mostly superficial, composed of branched, septate, interweaving, anastomosing, smooth, hyaline, 3 to 6 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight to arcuate or slightly flexuous, cylindrical, branching mostly basally, with branches sometimes originating opposite each other, infrequently arcuately branched above, occasionally anastomosing, smooth, septate, relatively thin-walled, denticulate primarily in the distal portions of the terminal and sub-terminal cells, truncate and tapering slightly towards the apex, hyaline, generally up to 200 µm long, 5 to 8 µm wide, tapering to 3 µm wide. Conidiogenous cells polyblastic, integrated, cylindrical, often tapered where terminal, determinate, bearing up to seven conspicuous, cylindrical denticles; generally 40 to 60 µm long, denticles typically 2 to 3 µm long, 3 µm wide, occasionally longer. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, smooth, moderately thick-walled, ellipsoid, bearing a prominent to slightly-projecting papilla or with a truncate base, hyaline to sub-hyaline, 17-22 × 10-12 µm in size.

On dead wood; Europe.

Specimen examined: on decayed wood of *Abies alba* Mill., virgin forest “Boubínský prales”, near Zátoň, distr. Vimperk, Czechoslovakia, 26 September 1968, V. Holubová-Jechová, PR 670955, holotype.

This species was classified by Holubová-Jechová (1980) in her section *Avesiculata*, subsection *Ellipsoidea*, which is characterized by the absence of any terminal or lateral vesicle-like swelling of the conidiophores and possession of ellipsoid conidia. It is similar in its general characteristics to both *H. conspersum* and *H. magnisporum*, but can be readily distinguished from either by certain small morphological details, including conidiophore dimensions, conidial size, and conidiogenous denticle distribution and length. Conidiophores of *Haplotrichum ellipsosporum* differ from those of *H. conspersum* in being somewhat more tapered toward the apex and in having conidiogenous denticles localized toward the upper reaches of the two distal conidiophore cells. In contrast, in the latter species the denticles occur over a greater distance, with up to four adjacent fertile cells, and are more scattered over the length of each cell, although again having a tendency to be concentrated toward the upper end. Moreover, the denticles in *H. conspersum* are more abundant and, generally, slightly shorter. Another distinguishing difference between these two taxa lies in colony coloration, that of *H. conspersum* lacking the yellowish tinge typical of *H. ellipsosporum*. The most obvious difference between *H. ellipsosporum* and *H. magnisporum* lies in conidium size, those of the latter being, as its specific epithet indicates, appreciably larger.

Haplotrichum laevisporum (Cooke) Partridge & Morgan-Jones, comb. nov. (Figure 7).

≡ *Zygodesmus laevisporus* Cooke, *Grevillea* 6:139, 1878.

≡ *Rhinotrichum laevisporum* (Cooke) Sumst., *Mycologia* 3:49, 1911.

≡ *Oidium laevisporum* (Cooke) Linder, *Lloydia* 5:200, 1942.

Teleomorph: unknown.

Colonies effuse, hypochnoid, becoming tomentose, pale ochraceous to tawny. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, smooth, hyaline, 3 to 6 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending and interweaving, simple or, more often, branched, with lateral branches frequently arising at close to right angles and becoming sharply curved to assume an orientation somewhat parallel to the main axis, flexuous to undulate to, sometimes, loosely spiralled, cylindrical, inflated at the apex, smooth, distantly septate, moderately thick-walled, sparsely denticulate, hyaline to very pale-brown, generally up to 300 µm long, 4 to 7 µm in diameter. Conidiogenous cells mostly monoblastic, sometimes bearing two or three conidiation loci, integrated, terminal or intercalary, occasionally discrete as lateral branches, mostly clavate, rarely somewhat bullate toward the apex, usually bearing one shallow, up to 2.5 µm long, conidiogenous denticle. Conidia acropleurogenous, holoblastic, solitary or, less often, in short chains of two or very rarely three, dry, unicellular, smooth, moderately thick-walled, with slight internal roughening at maturity, subglobose to globose, pale yellowish-brown, 9 to 12 µm in diameter.

On bark of *Magnolia* sp.; North America.

Specimen examined: Gainesville, Florida, USA, H.W. Ravenel, undated, [in Herb. M.C. Cooke] K; also as Ravenel, Fungi Americani Exsiccati 58, FH.

This species was considered to be near to *Haplotrichum curtisii* by Sumstine (loc. cit.), being distinguished mainly by the presence of but few conidiogenous denticles. It was, however, recognized as a separate entity by this author when he made the transfer into *Rhinotrichum*, and its independent status was subsequently maintained by Linder (loc. cit.), who noted also the paler color of its colonies. In addition, the latter author differentiated the two species by the fact that the conidiophore branching pattern varies, that of *H. laevisporum* being less spreading and more sharply ascending. With regard to the matter of conidiophore spiralling, Linder (loc. cit.), although mentioning this characteristic in his formal description of *O. laevisporum* and not in that of *O. curtisii*, apparently considered this a common feature between the two, judging from a comment made in his discussion of their differentiating criteria. The present authors concur with this view, although it should be pointed out that the conidiophores of *H. curtisii* are often generally straighter in aspect than is typical of *H. laevisporum*.

In the development of species concepts within this anamorph complex, there has, apparently, historically been some ambivalence and unevenness in the employment of defining characteristics, particularly where variation in certain features is evident. Interestingly, Linder (loc. cit.) listed the specimen collected by Roland Thaxter in Cullowhee, North Carolina, which the present authors consider to be *H. curtisii*, under both *O. curtisii* and *O. laevisporum*, which is, perhaps, indicative of there having been some doubt in his mind as to the distinctiveness of these two species. As has been discussed previously, although there exists, admittedly, something of a morphological continuum, and a wide range of form among recognized taxa in this genus, nevertheless the unique peculiarity of separate species can be readily discerned, even though the individual entities may, in some instances, be rather narrowly defined. This can, incidentally, also be said of the teleomorphs with which some of these mitosporic forms are associated.

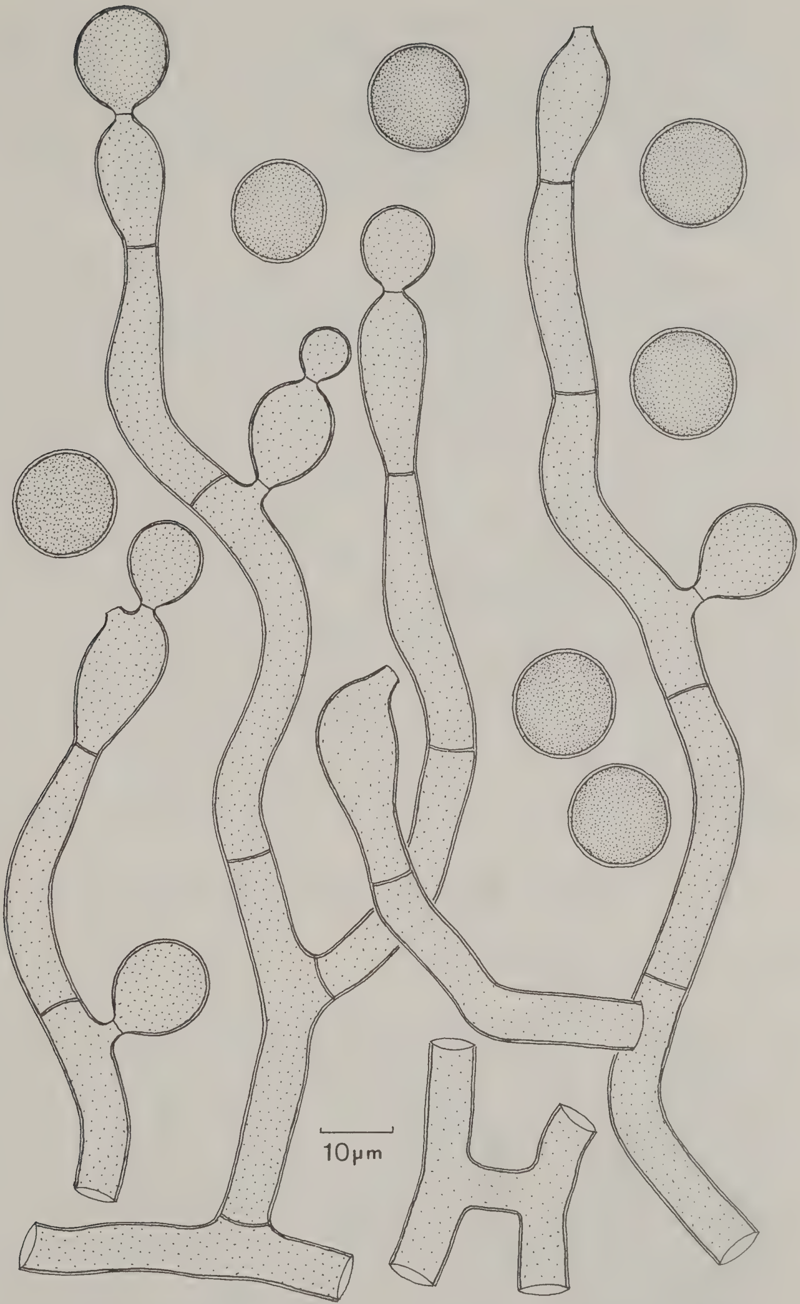

FIGURE 7. *Haplotrichum laevisporum*. Conidiophores and conidia.

The main distinction between *H. laevisporum* and *H. curtisii* lies in the conidiophores of the former, although having an undulating aspect, being simpler in form than those of the former. In this regard, *H. laevisporum* is somewhat reminiscent of such species as *H. album* (Sumst.) Hol.-Jech. and *H. simile* (Berk.) Hol.-Jech. In these taxa conidiogenous cells usually bear only one or two conidiation loci marked by short denticles or shallow, truncate, unthickened scars.

Holubová-Jechová (1969) listed *Oidium laevisporum* as a synonym of *Oidium curtisii*. By advisedly adopting a conservative position, however, and maintaining *H. laevisporum* as a separate entity, the equitable application of species concepts is emphasized herein. *Haplotrichum laevisporum* differs from *H. curtisii* to a similar extent as does *H. ovalisporium*, a taxon which was first described as a variety of it, but which Holubová-Jechová (1976) elevated to the species level. In this connection it should be noted that it is, admittedly, conceivable that *H. laevisporum* and *H. ovalisporium* represent further extreme forms of *H. curtisii*, a species which, as already discussed, is known to be highly variable. In the case of *H. laevisporum*, its morphology could, perhaps, be interpreted as a poorly developed form of *H. curtisii*, but yet the colonies in its type collection are extensive, appear to be fully formed, bear mature conidia, and are of a different color from that typical of *H. curtisii*. A final resolution of any question concerning species delimitations in this complex must await acquisition of further specimens.

Haplotrichum magnisporum (Linder) Hol.-Jech., *Česká Mykol*. 30:4, 1976 (Figure 8).

≡ *Oidium magnisporum* Linder, *Lloydia* 5:179, 1942.

Teleomorph: unknown.

Colonies effuse, low, hypochnoid, powdery, at first cream-colored, becoming buff to pale tan. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, smooth, hyaline, 3 to 7 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight to somewhat flexuous, cylindrical, branching generally at close to right angles, branches straight or gently curving to assume an orientation roughly parallel to the main stipe, occasionally anastomosing, smooth, septate, fairly thin-walled, denticulate, hyaline, generally up to 300 µm long, 6 to 8 µm in diameter, tapering distally. Conidiogenous cells polyblastic, integrated, terminal or intercalary, cylindrical, determinate, bearing a number of conspicuous, cylindrical

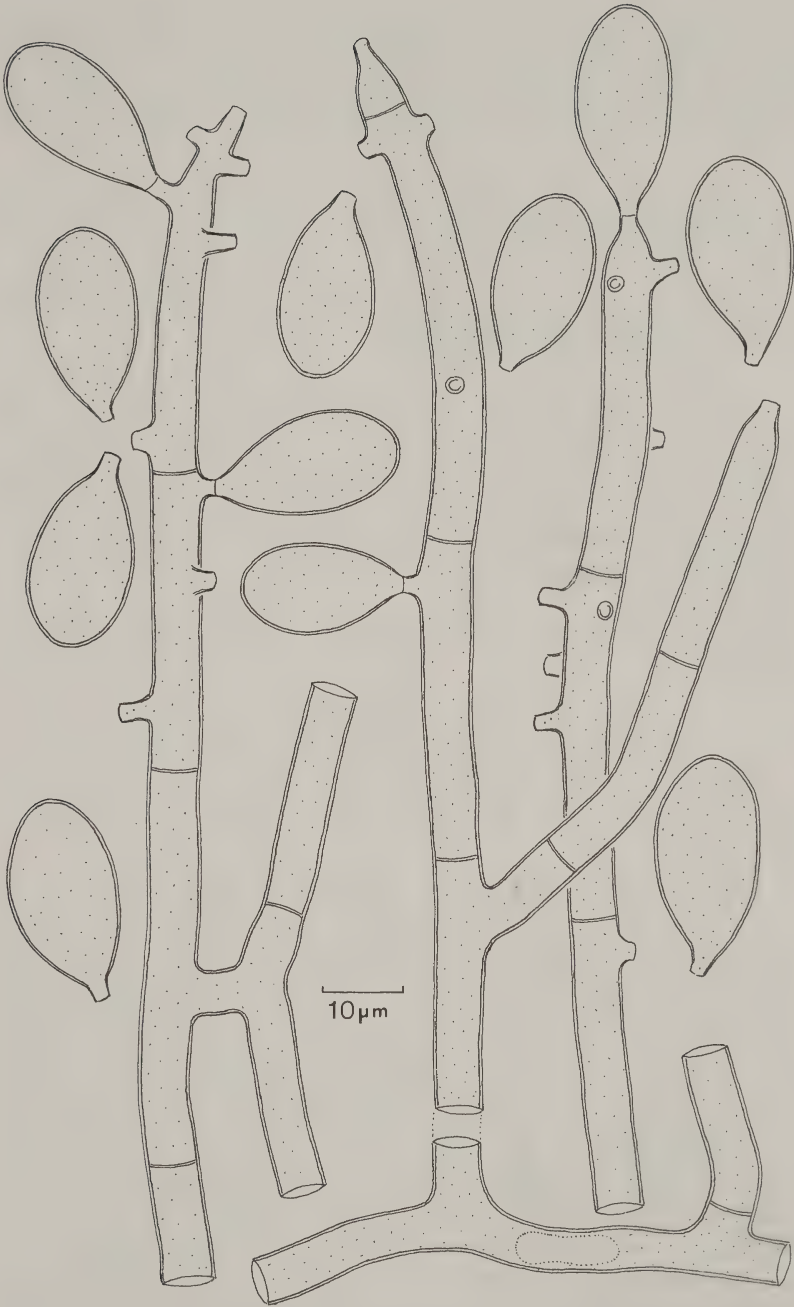

FIGURE 8. *Haplotrichum magnisporum*. Conidiophores and conidia.

denticles; typically 15 to 40 µm long, denticles 1.5 to 4 µm long, 2 to 3 µm wide. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, smooth, relatively thin-walled, obovate to ellipsoid, bearing a conspicuous, often obliquely-oriented papilla, hyaline to sub-hyaline, 23-27 × 12-14 µm in size.

On *Abies magnifica* A. Murray [= *A. magnifica* A. Murray var. *shastensis* Lemmon]; North America.

Specimen examined: Mount Shasta, Siskiyou County, California, USA, W.B. Cooke, 20 June 1938, FH, holotype.

As noted above in the discussion under *H. ellipsosporum*, *H. magnisporum* is broadly similar to both that species and *H. conspersum*. It can be readily differentiated from these taxa by the larger size of its conidia. Other distinguishing characteristics include the presence of more prominent conidial papillae, which are often oriented somewhat obliquely, and more sparsely denticulate conidiophores.

Haplotrichum medium (Hol.-Jech.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 9).

≡ *Oidium medium* Hol.-Jech., *Česká Mykol.* 23:215, 1969.

Teleomorph: *Botryobasidium medium* J. Erikss., *Symb. Bot. Ups.* 16:54, 1958.

Colonies effuse, hypochnoid, creamy-white, often somewhat thin, velvety when well-developed. Mycelium mostly superficial, repent, composed of branched, septate, interweaving, anastomosing, fibulate, but not invariably, smooth, hyaline, 4 to 7 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, branched, with branches at wide angles, frequently anastomosing, somewhat flexuous, smooth, septate, moderately thick-walled, cylindrical, denticulate, hyaline, generally up to 200 µm long, 4 to 8 µm wide. Conidiogenous cells mono- or polyblastic, integrated or discrete, determinate, terminal, or, more rarely, intercalary, or as lateral branches, cylindrical or, where terminal and lateral, broadly fusoid to narrowly ellipsoid, usually with up to three conidiation loci marked with broad, shallow, truncate denticles. Conidia acropleurogenous, holoblastic, in simple or branched, short chains, dry, unicellular, smooth, comparatively thin-walled, fusiform, somewhat clavate where terminally produced, with a

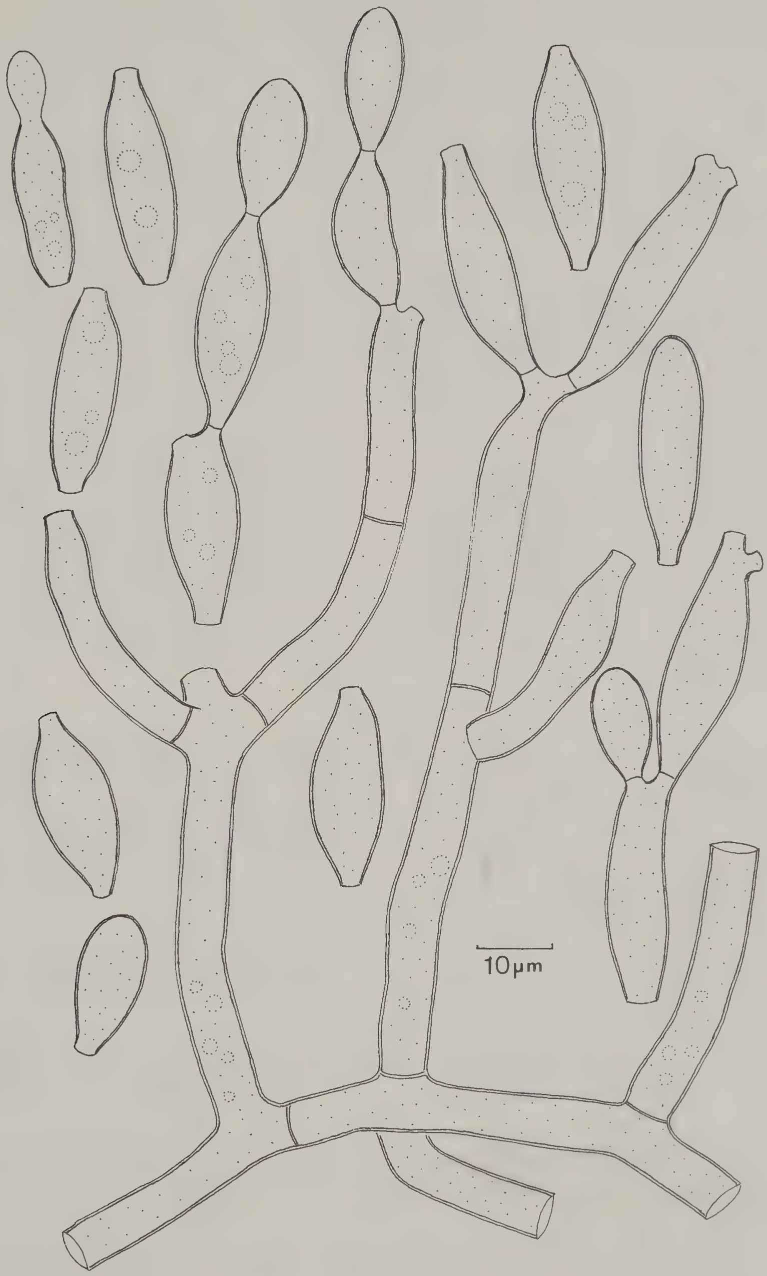

FIGURE 9. *Haplotrichum medium*. Conidiophores and conidia.

broad, truncate papilla at one or both ends, or with two distally where ramoconidial in form, often guttulate, hyaline, 14-25 × 5-8 μm in size.

On dead wood; cosmopolitan.

Specimen examined: on decayed wood, La Silla, boundary between Dto Federal and Edo Miranda, Venezuela, A.E. Liberta and N.J. Navas, 22 August 1975, BPI.

Among species of *Haplotrichum*, *H. medium* is readily distinguishable by its unique morphology, particularly in having fusoid conidia. Holubová-Jechová (1969) considered this species to be most similar to *Haplotrichum album* (Sumst.) Hol.-Jech. and *Haplotrichum dubium* (Pers.) W.A. Baker & Partridge [as *Oidium aureum* Link ex Fries]. Although having a broad resemblance to these taxa, it is, however, appreciably different from them in a number of respects, especially conidial shape and, in the case of *H. dubium*, coloration. The subgenus *Fibulinum* was established by Holubová-Jechová (1980) to accommodate *H. medium*, on account of possession of basal hyphae with clamp connections, the remaining species of the genus being classified in subgenus *Haplotrichum*, characterized by a non-fibulate condition. Hjortstam (loc. cit.), however, noted that not all hyphae of this taxon are provided with clamps.

This fungus has been reported to occur on a range of host substrates, including *Abies*, *Carpinus*, *Fagus*, *Picea*, *Pinus*, and *Quercus*, and appears to have a widespread distribution in Europe and North America [see Eriksson (loc. cit.), Eriksson and Ryvarden (1973), Jung (1987), and Langer (loc. cit.)]. There are also records of its occurrence in Africa (Hjortstam, loc. cit.) and Japan (Maekawa, 1991).

Haplotrichum morganii (Linder) Partridge & Morgan-Jones, comb. nov. (Figure 10).

= *Oidium morganii* Linder [as '*Oidium morgani*'], *Lloydia* 5:197, 1942.

= *Physospora elegans* Morgan, *Cincinnati Soc. Nat. Hist. J.* 18:44, 1885 [non *Physospora elegans* Cavara, *Rev. Mycol.* 11:182, 1889].

= *Coniophora elegans* (Morgan) Höhnel, *Ber. Dtsch. Bot. Ges.* 37:155, 1919.

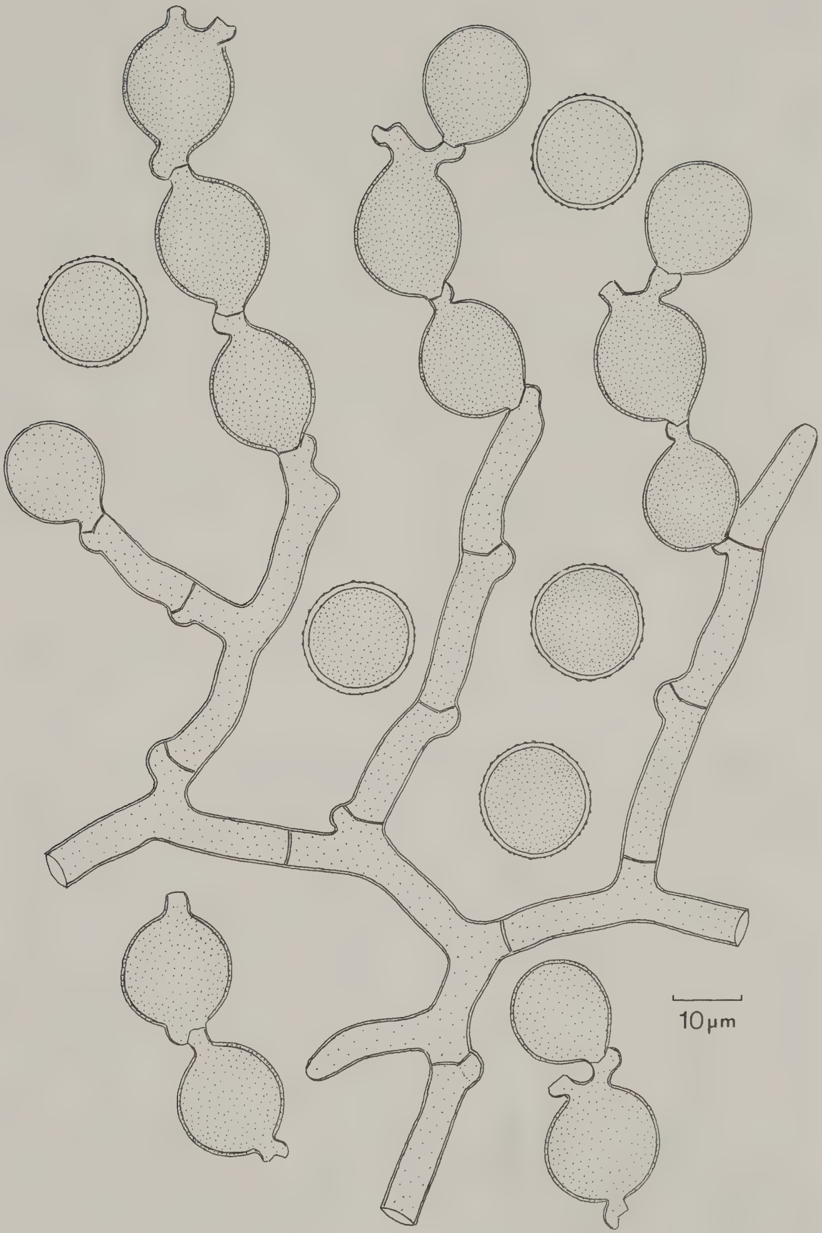

FIGURE 10. *Haplotrichum morgani*. Conidiophores and conidia.

Teleomorph: unknown.

Colonies effuse, powdery, ochraceous-buff in color. Mycelium mostly superficial, composed of abundantly branched, septate, fibulate, interweaving, repent, smooth, hyaline to very pale brown, 4 to 7 µm wide hyphae, which form a dense network. Clamp connections present at most hyphal septa. Conidiophores micronematous to semi-macronematous, mononematous, more or less ascending, slightly flexuous, simple or sparsely branched at wide angles, smooth, septate, fibulate, with walls of medium thickness, cylindrical, subhyaline to very pale brown, relatively short, up to 70 µm long, 5 to 7 µm wide. Conidiogenous cells monoblastic, integrated, terminal or intercalary, determinate, cylindrical, bearing a lateral shoulder at the conidiation locus, derived from a clamp connection, following conidial disarticulation. Conidia acropleurogenous, holoblastic, in simple or branched chains, with each subtended by a clamp connection, dry, unicellular, smooth or minutely verruculose, moderately thick-walled, subglobose to globose, pale to mid brown, 17 to 20 µm in diameter.

On decayed wood; North America.

Specimen examined: Preston?, Ohio, USA, A.P. Morgan, 8 March 1892, FH, holotype.

Haplotrichum morganii differs from other species of the genus in having predominantly micronematous, fibulate conidiophores which differ very little from the somatic hyphae. Its conidia, however, are closely similar to those of several other taxa accommodated in *Haplotrichum*. In possessing chains of conidia with a clamp connection at each delimiting septum, it resembles the *Haplotrichum* anamorph of *Botryobasidium ponderosum* [see below]. Although an annotation, dated 1970, exists on the type material, indicating examination by Dr. Věra Holubová-Jechová, no taxonomic revision of this species was proposed by this author, perhaps indicating some doubt on her part as to an appropriate alternative classification. Interestingly, Sumstine (loc. cit.) offered the opinion, sixty years earlier, that this species might be best accommodated in a new genus, noting also that it is closely allied to *Zygodesmus* Corda [a genus which Donk (1962) considered a *nomen dubium*]. Among anamorph form-genera which are known to have basidial teleomorphs, *H. morganii* somewhat resembles *Asterophora* Ditmar:Fr. and *Ptychogaster* Corda, the mitosporic states of *Nyctalis* Fr. and *Tyromyces* P. Karst., respectively. As is the case with *H. morganii*, conidia in both of these are formed in clamp-connected chains [see Sivanesan and Watling (1980)], but they differ by lacking pigmentation. (Many authors, incidentally, consider

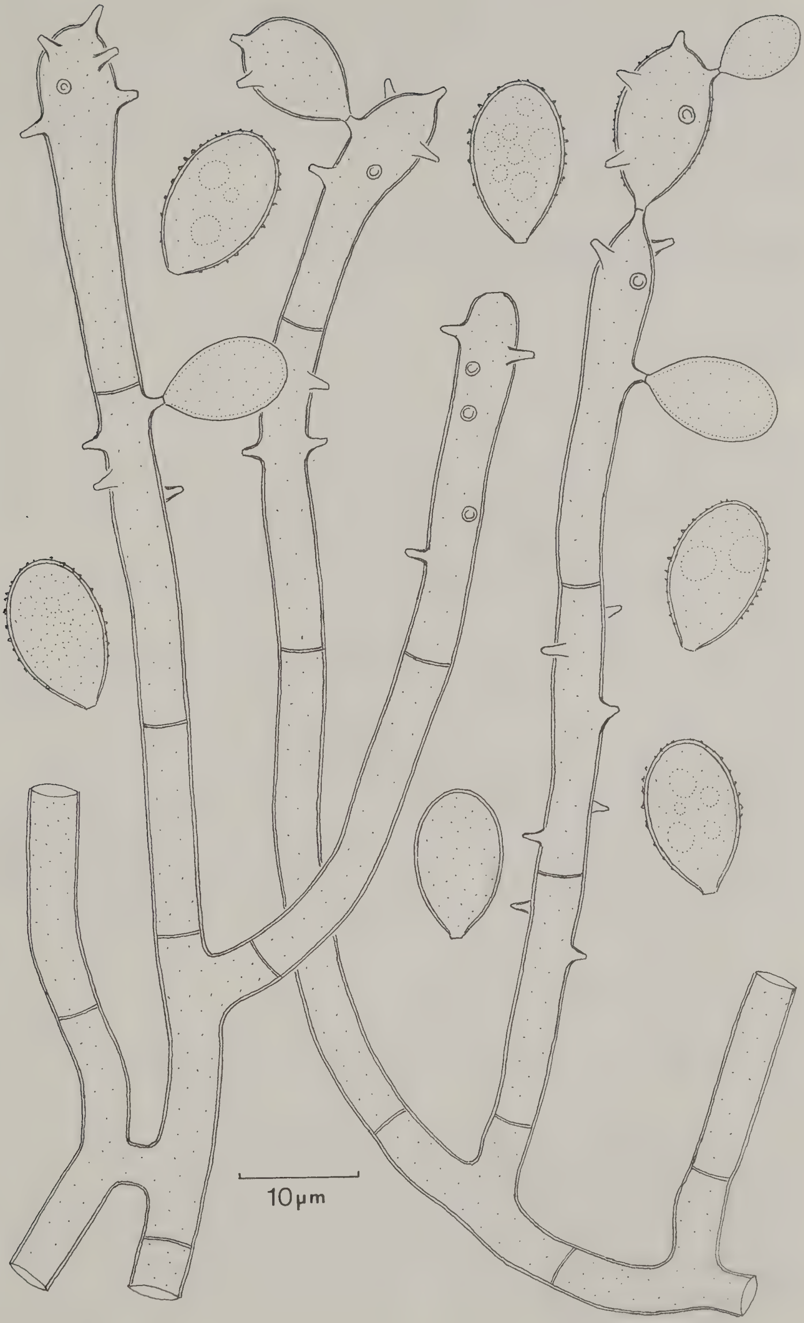

FIGURE 11. *Haplotrichum parmastii*. Conidiophores and conidia.

Asterophora a teleomorph genus with the anamorph correctly named *Ugola* Stalpers.) It is clear that the entity under consideration cannot continue to remain in taxonomic limbo in *Oidium* and, given the fact that its colony appearance, coloration, and conidia bear marked resemblance to some species of *Haplotrichum*, this genus seems, at present, the most appropriate place in which to classify it.

Haplotrichum parmastoi G. Langer [as '*Haplotrichum parmastii*'], *Folia Cryptog. Estonica* Fasc. 33:63, 1998 (Figure 11).

Teleomorph: unknown.

Colonies effuse, at first thin and discrete, becoming confluent, dense, whitish to pale grey. Mycelium mostly superficial, composed of branched, septate, interweaving, repent, smooth, hyaline, 2 to 12 μm wide hyphae. Conidiophores semi-macronematous, mononematous, erect, more or less ascending, occasionally anastomosing, abundantly branched at wide angles, with the distal portions of the lateral branches gradually curving upwards, straight to somewhat flexuous, cylindrical, smooth, septate, moderately thick-walled, denticulate, hyaline, up to 200 μm long, 3 to 7 μm wide. Conidiogenous cells polyblastic, integrated, terminal on main stipe or lateral branches, or intercalary, determinate, cylindrical to narrowly clavate where apical, usually bearing a number of small, narrowly cuneiform to spicule-like, up to 3 μm long, 1 to 2 μm wide denticles. Conidia acropleurogenous, holoblastic, solitary or in short chains, with vesicle-like primary ramoconidia bearing a number of secondary conidia, dry, unicellular, smooth or, more often, minutely verruculose, moderately thick-walled, guttulate, ellipsoid to obovate, hyaline to very pale yellowish, slightly papillate at the base, where ramoconidial bearing spicule-like denticles, 10-13 × 6-9 μm in size.

On dead wood; Central America.

Specimen examined: road to Bajola Hondura, 2 km north of San Jeronimo, Costa Rica, G. and E. Langer, 10 February 1989, K, holotype.

Langer and Langer (loc. cit.) classified *H. parmastoi* in Holubová-Jechová's section *Vesiculata*, subsection *Ramosa*, although noting that the infra-generic subdivision of *Haplotrichum* does not necessarily reflect natural affinities. Among other species placed therein, *H. parmastoi* most closely resembles *H. gracile* (Linder) Hol.-Jech. in conidiophore characteristics, including denticle shape.

Haplotrichum ponderosum Partridge et Morgan-Jones, sp. nov.

Coloniae effusae, resupinatae, hypochnoideae, densae, albidae vel pallide griseae. Mycelium plerumque superficiale, ex hyphis ramosis, septatis, fibulatis, repentibus, laevibus, hyalinis, 3-8 µm crassis compositum. Conidiophora micronemata vel semi-macronemata, mononemata, adscendentia, simplicia vel ramosa, leniter flexuosa, cylindrica, laevia, septata, fibulata, hyalina, usque ad 150 µm longa, 3-6 µm crassa. Cellulae conidiogenae mono- vel polyblasticae, in conidiophoris incorporatae, determinatae, terminales vel intercalares, cylindricae vel attenuatae, interdum disarticulatae. Conidia acropleurogena, holoblastica, solitaria vel catenata, sicca, aseptata, ad septis fibulata, laevia, fusiformia vel ellipsoidia, hyalina, 13-27 µm longa, 7-10 µm crassa.

In ligno emortuo *Pini ponderosi*, Black's Mountain Experimental Forest, Lassen National Forest, California, USA, M.J. Larsen, 13 June 1994, FP-135881, CFMR, holotypus.

Haplotrichum ponderosum Partridge & Morgan-Jones, sp. nov. (Figure 12).

Teleomorph: *Botryobasidium ponderosum* M.J. Larsen, *Mycotaxon* 60:430, 1996.

Colonies widely effuse, resupinate, hypochnoid, becoming dense, whitish to pale grey. Mycelium mostly superficial, composed of branched, septate, fibulate, interweaving, occasionally anastomosing, repent, smooth, hyaline, 3 to 8 µm wide hyphae, with clamp connections at all septa. Conidiophores micronematous to semi-macronematous, mononematous, ascending, more or less erect, simple or branched, with branches assuming a parallel orientation relative to the main stipe, straight to somewhat flexuous, cylindrical, smooth, septate, fibulate, relatively thin-walled, hyaline, generally up to 150 µm long, 3 to 6 µm wide. Conidiogenous cells mono- or polyblastic, integrated, determinate, terminal or intercalary, cylindrical but attenuating gradually where distal, sometimes disarticulating, bearing one or more lateral shoulders, derived from a clamp connections, following fragmentation or conidial detachment. Conidia acropleurogenous, holoblastic, solitary or in short chains, with a clamp connection at each delimiting septum, dry, unicellular, smooth, relatively thin-walled, fusiform to ellipsoid, hyaline, occasionally with minutely granular contents, obliquely papillate at one or both ends, often with a pronounced foot-like extension derived from a clamp connection, obtuse at the apex where terminally produced, 13-27 × 7-10 µm in size.

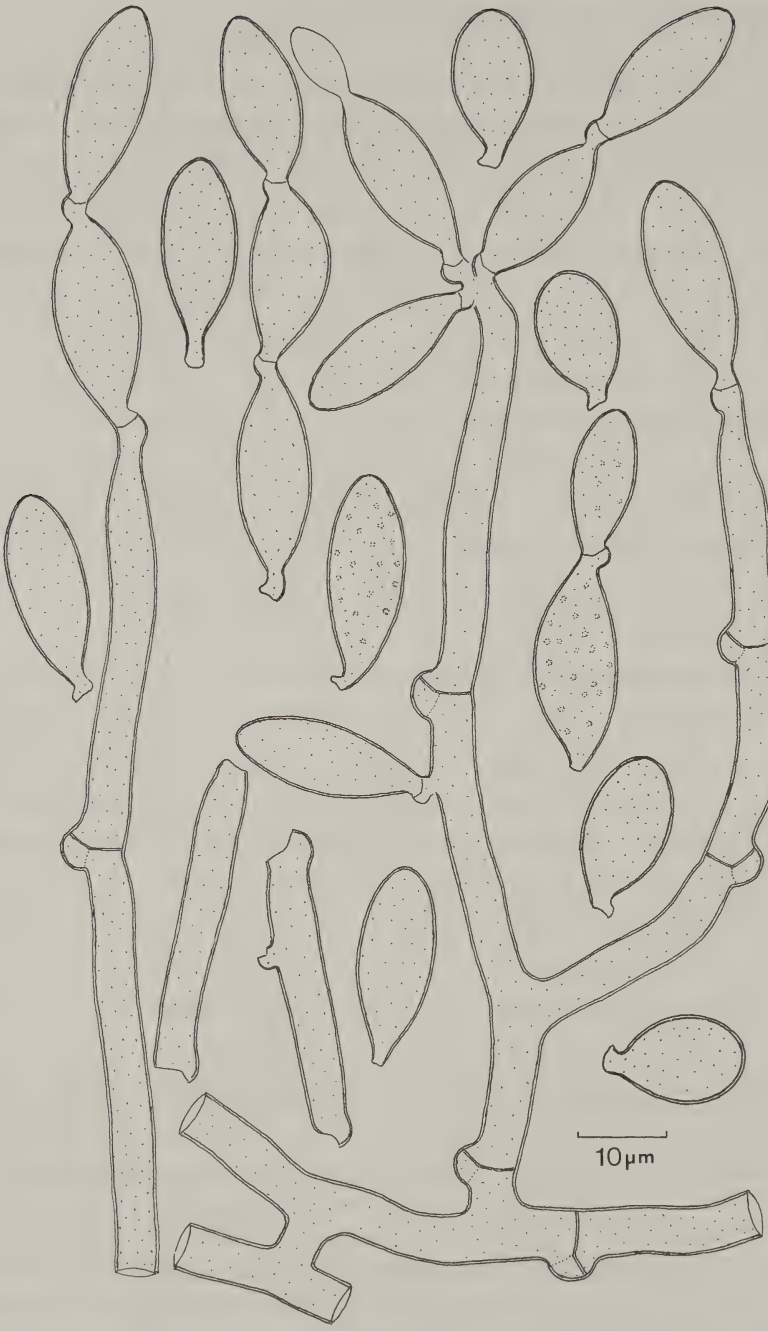

FIGURE 12. *Haplotrichum ponderosum*. Conidiophores and conidia.

On dead wood of *Pinus ponderosa* Douglas ex Lawson & C. Lawson; North America.

Specimen examined: Black's Mountain Experimental Forest, Lassen National Forest, California, USA, M.J. Larsen, 13 June 1994, coll. no. FP-135881, CFMR, holotype.

Together with *H. morganii*, this taxon is unique among species of *Haplotrichum* in having conidiophores that are little differentiated from somatic, vegetative hyphae, and in bearing clamp connections at all septa delimiting conidia. As noted by Larsen *et al.* (1996), *H. ponderosum* is similar to *H. medium*, but the latter lacks clamp connections on conidiophores and between conidia.

Haplotrichum pulchrum (Berk.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 13).

= *Rhinotrichum pulchrum* Berk., *J. Linn. Soc.* 13:175, 1873.

= *Oidium pulchrum* (Berk.) Linder, *Lloydia* 5:195, 1942.

Teleomorph: unknown.

Colonies effuse, spreading, hypochnoid, ochraceous. Mycelium mostly superficial, composed of branched, septate, interweaving, repent, smooth, subhyaline to very pale yellowish, 4 to 8 µm wide hyphae. Conidiophores semi-macronematous, mononematous, more or less erect, ascending, simple or branched, with branches curving upwards, occasionally anastomosing toward the lower reaches, straight to somewhat flexuous, cylindrical, smooth, septate, with wall of medium thickness, denticulate, with denticles located mainly in terminal or subterminal cells, subhyaline to yellowish, up to 400 µm long, 6 to 9 µm wide. Conidiogenous cells mono- or mostly polyblastic, integrated, terminal or intercalary, cylindrical, or, where apical, narrowly clavate, determinate, bearing one or more relatively broad, usually shallow, truncate, up to 3 µm long, 2 to 3 µm wide denticles. Conidia acropleurogenous, holoblastic, solitary or in short, branched chains, dry, unicellular, smooth, moderately thick-walled, ellipsoid to obovoid or, where intercalarily-produced, limoniform, bearing one or two broad, flat, shallow papilla or, where ramoconidial in form, with up to five papilla and/or denticles, yellowish, 14-19 × 10-13 µm in size.

On dead wood; Australia.

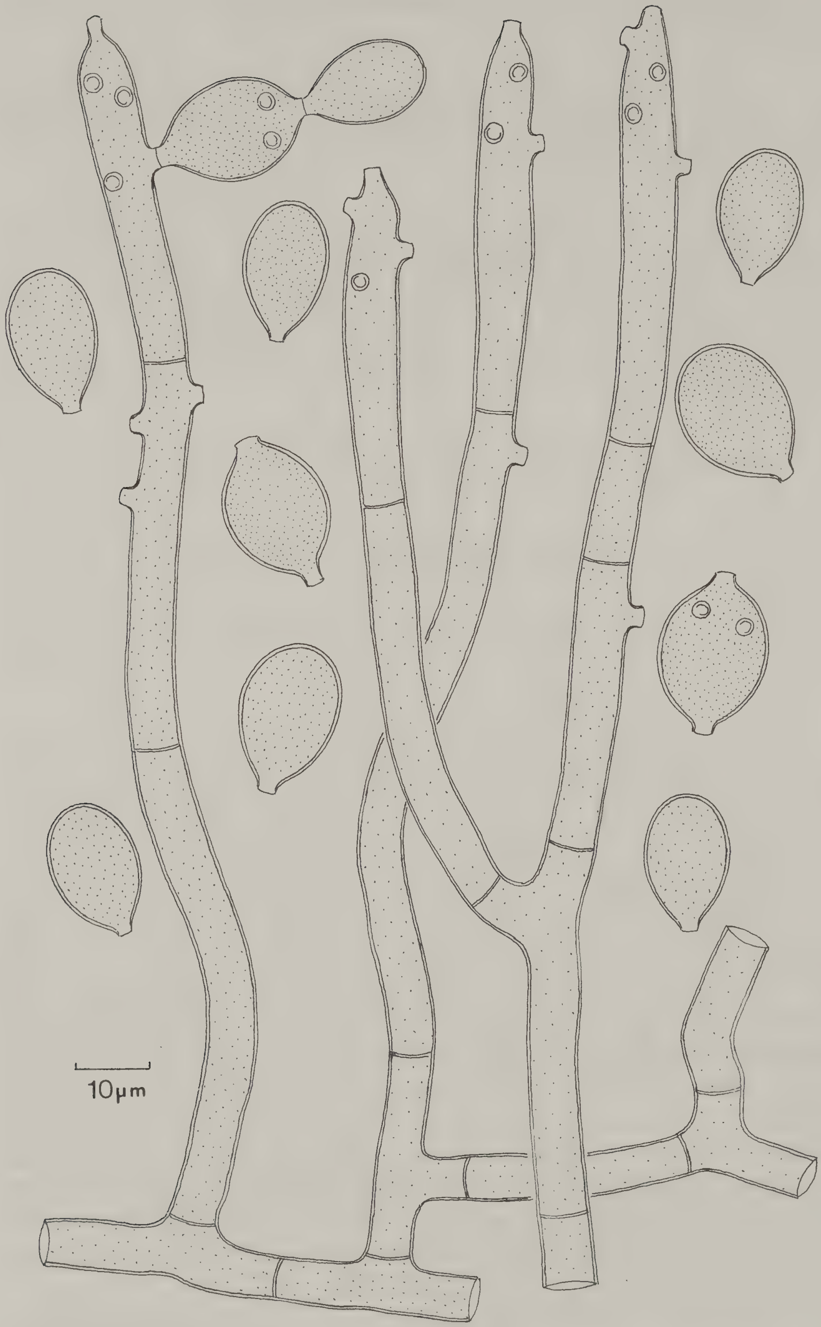

FIGURE 13. *Haplotrichum pulchrum*. Conidiophores and conidia.

Specimen examined: Wangaretta, New South Wales, Australia, Herb. Berk. 1879, K, holotype.

This species was classified by Holubová-Jechová (1980) in her section *Vesiculata*, subsection *Ramosa*. Of the other species placed therein, *H. pulchrum* most closely resembles *H. linderi* Hol.-Jech., but it differs from that taxon by, among other things, having terminal conidiophore cells which are generally longer and barely inflated. These two species can be further differentiated by conidiophore and conidium coloration, this being subhyaline to mid brown in *H. linderi*.

Haplotrichum pulveraceum (Ellis) Partridge & Morgan-Jones, comb. nov. (Figure 14).

= *Monilia pulveracea* Ellis, in Craigin, *Bull. Washburn Coll.* 1:69, 1884.

= *Rhinotrichum pulveraceum* (Ellis) Ellis & Everh., *Journ. Mycol.* 1:47, 1885.

= *Malbranchea pulveracea* (Ellis) Sumst., *Mycologia* 5:57, 1913.

= *Oidium pulveraceum* (Ellis) Linder, *Lloydia* 5:181, 1942.

Teleomorph: unknown.

Colonies effuse, thin, powdery, at first yellowish, becoming yellow-ochre with age. Mycelium mostly superficial, composed of branched, septate, interweaving, smooth, hyaline to very pale yellowish, 2 to 5 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, simple or occasionally branched, mostly straight, smooth, cylindrical, septate, sometimes with individual cells somewhat inflated and tending to disarticulate, with walls of medium thickness, denticulate, subhyaline to pale yellowish, generally up to 300 µm long, 4 to 7 µm wide. Conidiogenous cells mostly monoblastic, sometimes polyblastic, particularly where intercalary, integrated or discrete as short, lateral branches, terminal or intercalary or lateral, cylindrical to somewhat clavate or fusoid, determinate, bearing one or more broad, shallow, truncate, slightly projecting, up to 2 µm long, 1 µm wide denticles. Clavate, lateral conidiogenous cells sometimes becoming very thick-walled and disarticulating as conidia. Conidia acropleurogenous, holoblastic, solitary or in simple or branched chains, dry, unicellular, smooth, moderately thick-walled but often becoming very thick-walled at maturity, ranging in shape from subglobose to ellipsoid to obovoid or fusoid, subhyaline to pale yellowish, slightly apiculate at one or both ends, occasionally with an additional obliquely-positioned denticle where ramoconidial in form, 6-21 × 4-8 μm in size.

On dead wood; North America.

Specimen examined: Gray Summit, Missouri, USA, D.H. Linder, 10 April 1929, FH.

Holubová-Jechová (1969) listed *H. pulveraceum* among species which she considered candidates for exclusion from the genus *Oidium*, but gave no reason for this opinion. This taxon had been classified, "with some hesitation", in *Malbranchea* Sacc. by Sumstine (1913), but was subsequently transferred into *Oidium* by Linder (loc. cit.). It clearly does not belong in the former genus [for its characteristics see Sigler and Carmichael (1976)].

Linder (loc. cit.), although not mentioning the feature in his formal description of *H. pulveraceum*, reported, in discussing the species, occurrence of clamp connections, but noted these to be inconspicuous. Occasional swellings proximal to some transverse septa have been observed by the present authors, but it is uncertain if such represent a true fibulate condition. A possible basidiomycetous affinity is, therefore, indeterminable.

Notwithstanding the fact that *H. pulveraceum* differs to some extent from what can be considered the typical morphological form exemplified by most species of *Haplotrichum*, it nevertheless fits satisfactorily within this genus as conceptualized and circumscribed in the current study. Although it possesses some anomalous features, these are also present in several other taxa included in the genus. The tendency of conidiophore cells to disarticulate and break apart is a phenomenon seen also in *Haplotrichum tenerum* (Sumst.) Hol.-Jech. It should also be noted that terminal conidiogenous cells in such species as *H. curtisii*, *H. medium*, and *H. ovalisporium* occasionally disarticulate. In terms of conidial wall thickness, *H. pulveraceum* is comparable to *H. croceum* and *H. perseae* [see Castañeda Ruíz (1996)]. In general aspect, the conidiophores and conidial chains of *H. pulveraceum* have some resemblance to those of species such as *Haplotrichum album* (Sumst.) Hol.-Jech., particularly with regard to orientation and shortness of interconidial isthmi. The shallowness of conidial denticles is a peculiarity which this species shares with *H. album* and *Haplotrichum chilense* (Linder) Hol.-Jech.

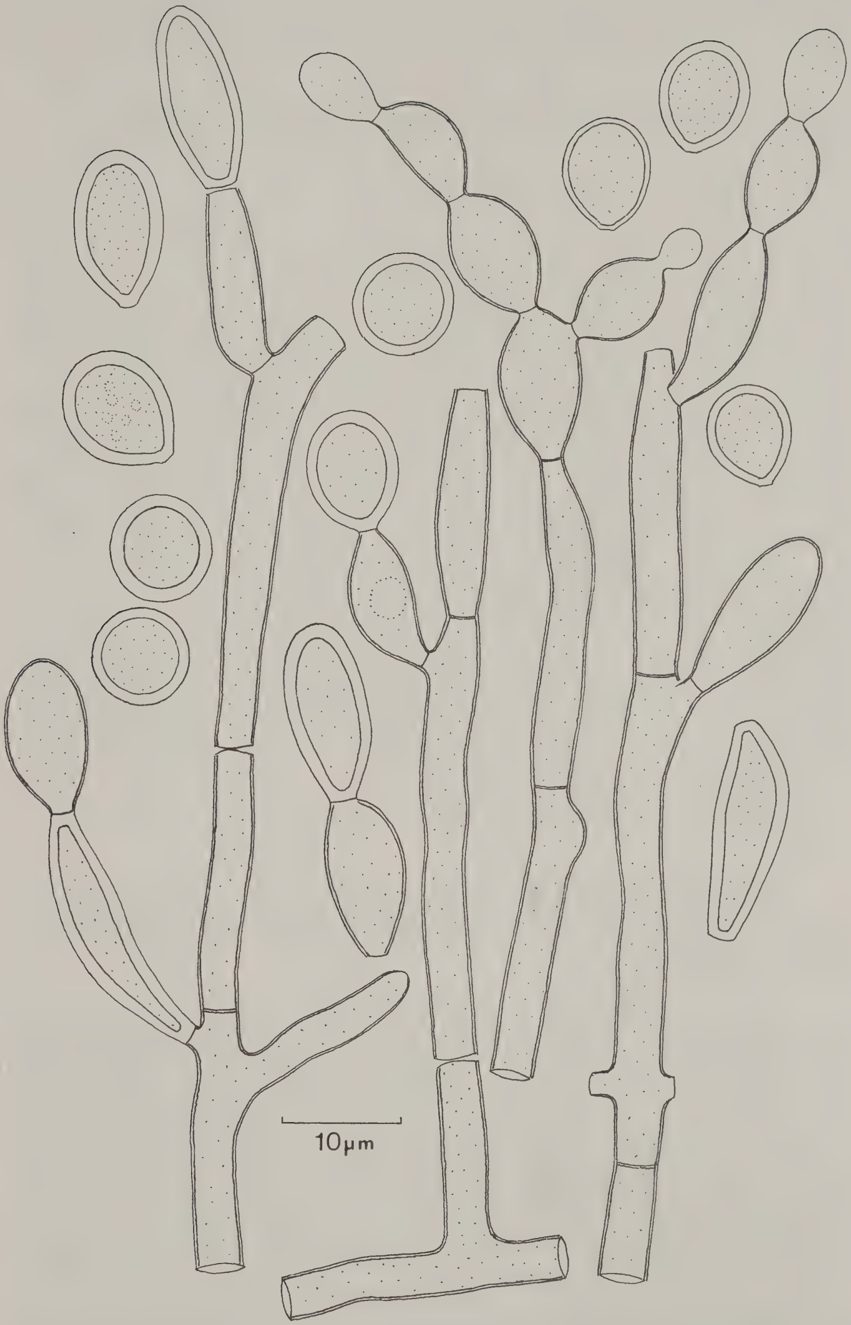

FIGURE 14. *Haplotrichum pulveraceum*. Conidiophores and conidia.

Haplotrichum sphaerosporum (Linder) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 15).

= *Oidium sphaerosporum* Linder, *Lloydia* 5:200, 1942.

Teleomorph: unknown.

Colonies effuse, hypochnoid, powdery to lanose, yellowish-buff in color. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, repent, smooth, hyaline to very pale yellowish, 2 to 5 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight to gently flexuous or arcuate, cylindrical, branching at varying angles, mostly at right angles below and at closer angles apically, occasionally anastomosing, smooth, septate, comparatively thin-walled, denticulate along most of their length, sometimes vacuolated, hyaline to pale yellowish, generally up to 350 µm long, 6 to 8.5 µm wide, tapering distally to 3 to 4 µm wide. Conidiogenous cells polyblastic, integrated, cylindrical, determinate, generally 35 to 50 µm long, bearing a number of conspicuous, cylindrical to cuneate, 1 to 2 µm long, 2 to 3 µm wide denticles. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, relatively thin-walled, with the outer wall becoming minutely verruculose to echinulate and somewhat thickened with age, globose to subglobose, sometimes bearing a small papilla, subhyaline to very pale brown, 10 to 13 µm in diameter.

On dead wood; North America.

Specimen examined: in moist forest, 7000 ft. elev. along the Tepeite River, near Cuernavaca, Mexico, W.A. and E.A. Murrill (545), 28 December 1909, FH, holotype.

This species was classified by Holubová-Jechová (1980), together with *H. tenerum*, in her section *Avesiculata*, subsection *Sphaeroidea*. Among species with globose conidia, *H. sphaerosporum* bears some resemblance to *H. armeniacum* and *H. tenerum*, but is readily distinguishable from both. It is unlike the former in that it possesses smooth conidiophores which lack clamp connections. It differs from the latter in conidium size and wall thickness, as well as in having conidiophores which do not break apart. The external ornamentation of its conidial wall is distinctive, this being a feature not common among species of *Haplotrichum*, although occurring also in *H. morganii* and *H. parmastoi*.

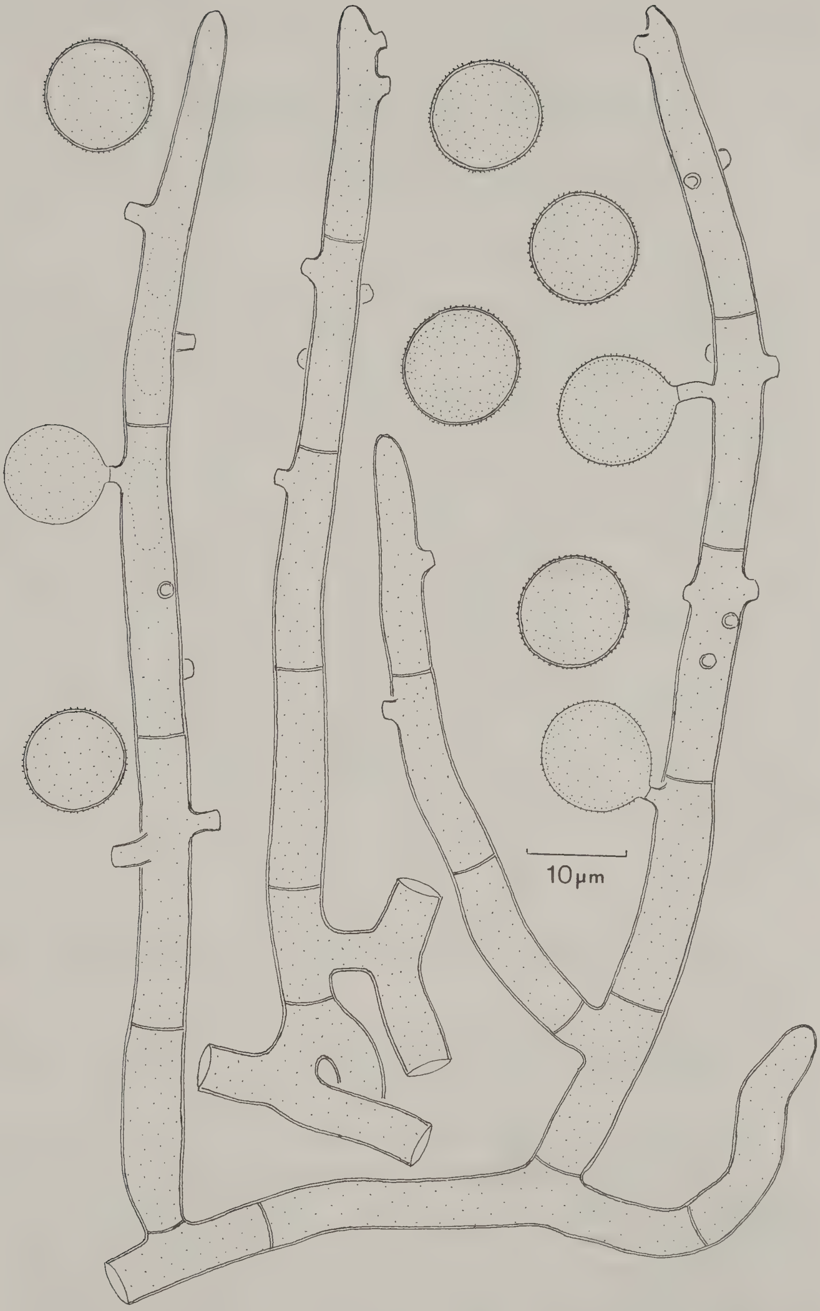

FIGURE 15. *Haplotrichum sphaerosporum*. Conidiophores and conidia.

Haplotrichum tenerum (Sumst.) Hol.-Jech., *Česká Mykol.* 30:4, 1976 (Figure 16).

≡ *Rhinotrichum tenerum* Sumst., *Mycologia* 3:51, 1911.

≡ *Oidium tenerum* (Sumst.) Linder, *Lloydia* 5:180, 1942.

Teleomorph: unknown.

Colonies effuse, thin, hypochnoid, powdery, creamy buff to buff yellow. Mycelium mostly superficial, composed of branched, septate, interweaving, occasionally anastomosing, repent, smooth, hyaline to subhyaline, 3 to 6 µm wide hyphae. Conidiophores semi-macronematous, mononematous, ascending, more or less erect, straight or somewhat flexuous, cylindrical, occasionally branching, branches curving rather sharply to assume a position generally parallel to the main stipe, frequently anastomosing, smooth, septate, with the transverse septa unevenly thickened, being wider where adjoining the periclinal wall, individual cells often disarticulating to leave a truncate terminus, comparatively thin-walled, denticulate, hyaline to subhyaline, generally up to 300 µm long, 5 to 9.5 µm in diameter. Conidiogenous cells polyblastic, integrated, cylindrical to clavate, determinate, bearing a number of conspicuous, cylindrical denticles; typically 15 to 40 µm long, denticles generally 2 × 2 µm, up to 3 µm long, 4 µm wide. Conidia acropleurogenous, holoblastic, solitary, dry, unicellular, smooth, becoming progressively thicker-walled, walls up to 1 u thick, subhyaline, extremely cyanophilic, cellular contents appearing granular with age, subglobose to obovoid, occasionally bearing a small papilla, 8.5 to 12 µm in diameter.

On dead wood and polyporaceous fruit bodies; North America and Caribbean.

Specimen examined: inside of hollow oak tree, Louisiana, USA, A.B. Langlois, 20 January 1896, FH, isotype.

In general aspect, the conidiophores of *H. tenerum* resemble those of *H. conspersum*, but these two taxa differ in the shape of their conidia, those of the latter being ellipsoidal. Conidiophore disarticulation at the unevenly thickened transverse septa is a particularly distinctive feature of *H. tenerum*. Where anastomoses occur, this breaking apart results in the freeing of what Linder (loc.cit) referred to as “H-shaped structures”. These are commonly seen in specimens of this species.

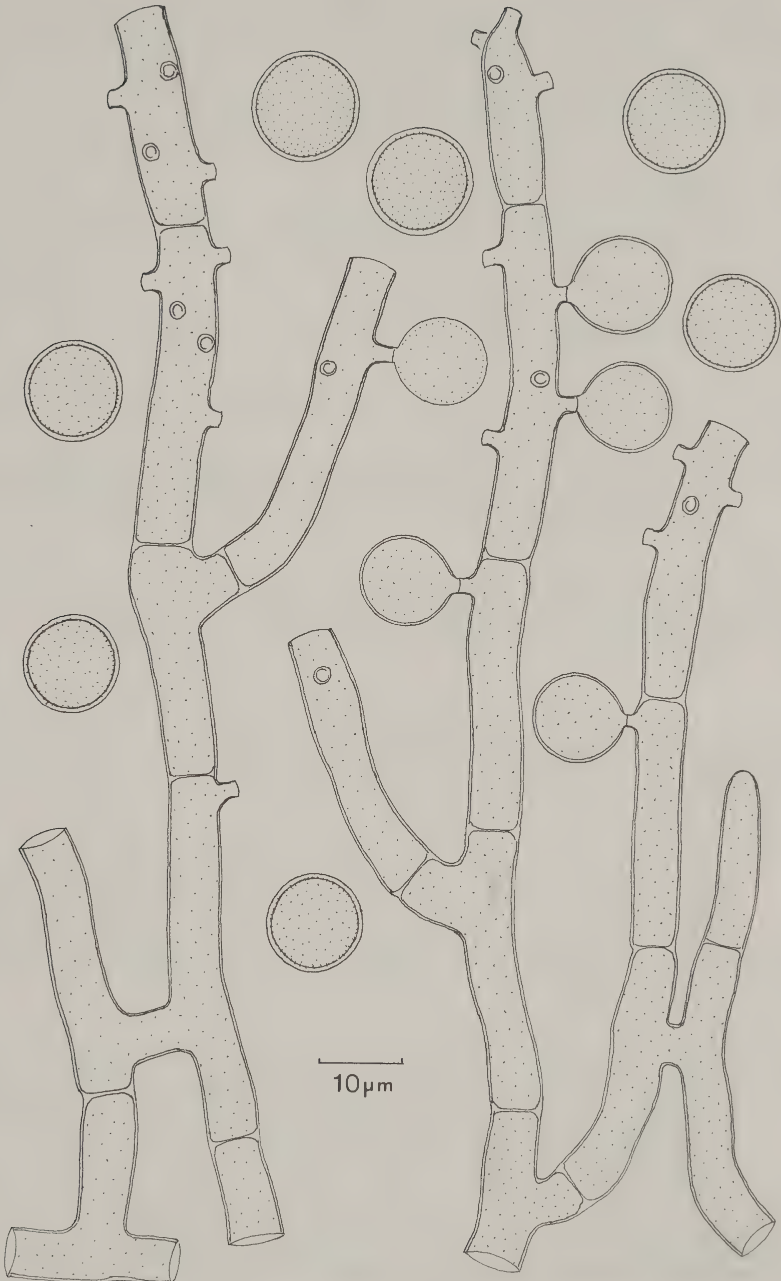

FIGURE 16. *Haplotrichum tenerum*. Conidiophores and conidia.

KEY TO SPECIES OF HAPLOTRICHUM[*]

1. Conidia mostly globose: 2
1. Conidia mostly not globose: 10

2. Conidia hyaline/sub-hyaline: 3
2. Conidia melanized to varying degrees: 5

3. Conidia 11-14 µm in diameter, with verruculose, thick, tunica-like outer wall: *H. perseae.*[†]
3. Conidia not as above: 4

4. Conidia minutely verruculose or echinulate, generally 10-13 µm in diameter: *H. sphaerosporum.*
4. Conidia smooth-walled, generally 8.5-12 µm in diameter; conidiophore septa unevenly thickened; individual conidiophore cells tending to disarticulate: *H. tenerum.*

5. Conidia in simple or branched chains subtended by clamp connections; most hyphal and conidiophore septa fibulate: *H. morganii.*
5. Not as above: 6

6. Conidiophores mostly straight, with scattered, shallow (1 µm), flat denticles; conidia pale to mid brown: *H. tomentosum.*
6. Not as above: 7

7. Conidiogenous cells, especially where lateral, somewhat vesicular in nature, with up to eight prominent, well-developed (2-5 µm long) denticles; conidia brown and thick-walled when mature, with the inner wall layer appearing irregularly stratified or minutely pitted: *H. rubiginosum.*
7. Not as above: 8

8. Conidiophores with occasional clamp connections; irregularly-shaped, well-developed (2-6 µm long) denticles present, mostly in the sub-apical conidiophore cell; conidia pale yellowish: *H. armeniacum.*
8. Not as above: 9

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[*] Note: *Parahaplotrichum idahoense* is included for comparative purposes.

[†] Data derived from Castañeda Ruíz (1996).

9. Conidiogenous cells mostly polyblastic, broadly clavate to obovoid, occasionally somewhat vesicular; conidiophores 7-11 μm in diameter: *H. curtisii*.
9. Conidiogenous cells mostly monoblastic, clavate, non-vesicular; conidiophores 4-7 μm in diameter: *H. laevisporum*.

10. Conidia solitary, or vesicular/ramoconidial cells not present: 11
10. Conidia in chains of at least two, or vesicular/ramoconidial cells present: 16

11. Conidia obovoid to ellipsoid, 23-27 × 12-14 μm in size, hyaline to sub-hyaline: *H. magnisporum*.
11. Conidia not as above: 12

12. Extensive, dendritically-branching denticles present; conidia pale to mid brown, 16-24 × 9-14 μm in size: *H. caribense*.
12. Not as above: 13

13. Conidia very thick-walled (up to 3 μm), obovoid to ellipsoid, 16-28 × 12-21 μm in size, yellow-brown to red-brown, sometimes with basal frill: *H. croceum*.
13. Conidia not as above: 14

14. Small (2 × 2 μm), cuneiform to spicule-like denticles present, mostly on terminal and sub-terminal conidiophore cells; conidiogenous cells narrowly clavate; conidia mostly obovate, very rarely in short chains, 11-21 × 7-9 μm in size: *H. gracile*.
14. Not as above: 15

15. Conidiogenous denticles concentrated in the upper portions of the two distal conidiophore cells; colonies with yellowish coloration: *H. ellipsosporum*.
15. Conidiogenous denticles occurring on up to four adjacent conidiophore cells and scattered over the length of those cells; colonies snuffy-brown to leather-colored: *H. conspersum*.

16. Conidia yellow to brown: 17
16. Conidia mostly hyaline to sub-hyaline: 20

17. Conidia somewhat limoniform, in branching chains of three or more; conidiogenous cells occasionally colored: 18
17. Not as above: 19

18. Conidia limoniform to fusiform, 14-27 × 7-13 μm in size: *H. dubium.*
18. Conidia somewhat limoniform to broadly ellipsoid, 18-25 × 14-17 μm in size; conidiogenous cells sometimes inflated below terminal conidiation locus; longer, colored conidiophores occasionally present: *H. simile.*

19. Conidia 9-16 × 9-12.5 μm in size, mostly without discernible papillae; conidiophores with branches at wide angles, gently curved: *H. ovalisporium.*
19. Conidia 15-19 × 10-14 μm in size, mostly with discernible papillae; conidiophore branches at wide angles but tending to orient parallel to main stipe: *H. linderi.*

20. Conidiophores often markedly geniculate and attenuating terminally; vesiculose, globose to pyriform ramoconidia abundant, remaining conidia mostly obovoid, narrowly sub-truncate at the base, 11-20 × 9-12 μm in size: *H. vesiculosum.*
20. Not as above: 21

21. Conidia mostly fusoid to narrowly ellipsoid: 22
21. Conidia not as above: 26

22. Conidia broadly fusoid to somewhat limoniform, 7-12 × 3-5 μm in size, arising from densely caespitose conidiophores: *Parahaplotrichum idahoense.*
22. Not as above: 23

23. Clamp connections present at all hyphal and conidiophore septa, as well as between conidia; conidia fusoid to ellipsoid, 13-27 × 7-10 μm in size: *H. ponderosum.*
23. Not as above: 24

24. Clamp connections present at some hyphal septa; conidia fusoid or somewhat clavate, 14-25 × 5-8 μm in size: *H. medium.*
24. Not as above: 25

25. Conidia fusoid, 23-45-(70) × (5)-7-10-(13)μm in size: anamorph of *Botryobasidium latisporum.*[††]
25. Conidia fusoid, 23-40 × 7-10 μm in size: anamorph of *Botryobasidium longisporum.*[††]

[††] Data derived from Langer and Langer (1998).

26. Conidia often minutely verruculose, ellipsoid to obovoid, 10-13 × 6-9 µm in size; denticles narrowly cuneiform or spicule-like: *H. parmastoi.*
26. Not as above: 27

27. Conidiophores short (less than 100 µm long); conidiogenous cells clavate, mostly with only one conidiation locus; denticles present only as broad, barely-discernible, shallow projections, often obliquely-oriented; conidia more or less ellipsoid, but often asymmetrical: *H. album.*
27. Not as above: 28

28. Denticles present only as shallow, broad, barely-discernible projections; conidia ellipsoid to obovoid, 13-16 × 10-11 µm in size, in short, simple or branched chains, with no vesicular conidiogenous cells present: *H. chilense.*
28. Not as above: 29

29. Conidiophores branching heavily at wide angles, often with cruciate aspect; conidia 8-21 × 7-10 µm in size, in branching chains; well-developed (up to 4 × 3 µm) denticles present on conidiogenous cells and generally more than three well-developed denticles present on vesiculose cells/ramoconidia: *H. ramosissimum.*
29. Not as above: 30

30. Conidia varying in shape from subglobose to ellipsoid to obovoid or fusoid, 6-21 × 4-8 µm in size, occasionally becoming very thick-walled (2 µm or more thick); colonies yellow to yellow-ochre: *H. pulveraceum.*
30. Not as above: 31

31. Conidia ellipsoid to obovoid, or somewhat limoniform where produced intercalarily, 14-19 × 10-13 µm in size: *H. pulchrum.*
31. Not as above: 32

32. Conidia 11-13 × 8-10 µm in size; colonies whitish, becoming pale- to cinnamon-buff in color: *H. capitatum.*
32. Conidia 10.5-20 × 7-10 µm in size; colonies yellow ochre to apricot in color: *H. ochraceum.*

DISCUSSION

As has been discussed elsewhere (Partridge *et al.*, 2001a), the broad conceptualization and circumscription of the genus *Haplotrichum* adopted by the present authors reflects an apparently close phylogenetic affinity among the recognized taxa, although they are morphologically quite variable. It certainly seems appropriate, given the state of our current knowledge, to classify all known mitosporic states of *Botryobasidium* in a single nomen anamorphosis. To do otherwise, by the maintenance of several form-genera which are, in reality, artificial in nature and based purely on what are, in essence, phylogenetically uninformative morphological differences, serves no useful purpose except, perhaps, somewhat facilitating identification. In adopting this position, it is realized that traditionally-held generic concepts are, to some extent at least, being disregarded. Despite the morphological diversity extant within the genus, as already mentioned, a certain continuum exists which, we believe, justifies the taxonomic decisions reached previously (Partridge *et al.*, 2001a) and those contained herein. A caveat should be added, however, that in the case of several species, such as *H. morganii* and *H. pulveraceum*, further study is required to ultimately determine the suitability of their classification within *Haplotrichum*.

Langer (loc. cit.) and Langer and Langer (loc. cit.) noted that *Botryobasidium* species and their anamorphs are characterized by a septal pore type with continuous parenthesomes. Determination of the septal peculiarities of *Haplotrichum* species not known to have a *Botryobasidium* teleomorph should provide additional evidence as to the appropriateness, or otherwise, of their present classification.

NOMENCLATORIAL ADDENDUM

In our initial contribution on the *Acladium-Alysidium-Haplotrichum* complex (Partridge *et al.*, 2001a), the nomenclators for the respective type species of these three generic names were derived predominantly from Hughes (1958). It has subsequently come to our attention that several additional obligate and facultative synonyms of *Haplotrichum capitatum* (Link) Link, the lectotype species of *Haplotrichum* Link, exist. In order to provide a full nomenclator for this taxon, such is documented below.

Haplotrichum capitatum (Link) Link, in Willdenow, Linné *Species Plantarum*, edn IV, 6(1):52, 1824.

= *Acladium capitatum* Link, *Mag. Ges. naturf. Freunde*, Berlin, 3:11, 1809.

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= *Physospora albida* Höhn., *Ann. Mycol.* 1:527, 1903.[*]

= *Nematogonium album* Bainier, *Bull. Soc. mycol. Fr.* 21:227, 1905.[*]

Teleomorph: *Botryobasidium candicans* J. Erikss., *Svensk Bot. Tidskr.* 52:6, 1958.

[†] *fide* Holubová-Jechová (1969).

[*] *fide* Linder (1942). Note: when Linder (loc. cit.) made the combination *Oidium candicans* (Sacc.) Linder, the binomial *Nodulisporium album* was not taken up as the basionym for this anamorph although it predates *Monilia candicans* Sacc. By adopting the former and transferring it into *Oidium*, a later homonym of *Oidium album* Sumst. (Sumstine, 1914) [a different entity now known as *Haplotrichum album* (Sumst.) Hol.-Jech.], would have been created. Linder (loc. cit.) was presumably unaware of the fact that *Acladium capitatum* was the first name ever applied to this anamorph.

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NOTES ON HYPHOMYCETES. LXXXVII. RHEXOACRODICTYS, A NEW SEGREGATE GENUS TO ACCOMMODATE FOUR SPECIES PREVIOUSLY CLASSIFIED IN ACRODICTYS

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ABSTRACT

Four dematiaceous anamorphs, *Acrodictys erecta*, *A. fimicola*, *A. fuliginosa,* and *A. queenslandica,* are reclassified in a novel genus, *Rhexoacrodictys*, on the basis of significant differences in morphology and, particularly, peculiarities of the conidial detachment process, which involves rhexolytic disarticulation. *Acrodictys sacchari* and *A. satwalekeri* are considered to be conspecific with *A. fimicola* and *A. erecta*, respectively, and the former binomials are, consequently, relegated to the status of facultative synonyms. Three of these taxa are redescribed and illustrated. Further comments are made on the heterogeneous nature of *Acrodictys*.

KEYWORDS: *Endophragmiella*, *Junewangia*, generic concepts.

INTRODUCTION

Following a preliminary review of the respective morphological characteristics of the more than thirty taxa classified in *Acrodictys* M.B. Ellis, Baker *et al.* (2001a, 2001b) reached the conclusion that this entity has become a progressively and unduly heterogeneous assemblage of species. This genus was, in fact, rather broadly conceptualized from the very beginning [see Ellis (1961)]. With regard to the diversity of taxa classified within it, *Acrodictys* has had a history parallel to such genera as *Endophragmia* Duvernoy & Maire and *Sporidesmium* Link, reaching a similarily unsatisfactory state. Both of the latter genera have, in recent years, been substantially dismembered. *Acrodictys* likewise is in need of substantive revision and a narrowing of its circumscription is desirable, with particular attention being focused on certain key, taxonomically-important features. What has happened in *Acrodictys*, as in the case of a number of other genera of dematiaceous Hyphomycetes, is that taxa have essentially been added rather indiscriminately on the basis of general characteristics, without due regard being paid to such conservative and phylogenetically informative features as conidiophore secondary-growth peculiarities in relation to serial conidiation, patterns of conidial septation, and the precise method of conidium detachment. Possession of macronematous, thick-walled, well-melanized conidiophores which proliferate percurrently and produce brown, variously-shaped, dictyosporous conidia holoblastically and solitarily has been the overriding justification for including many species in *Acrodictys*, regardless of several other important defining characteristics.

An initial contribution toward resolution of some of the anomalies inherent in the present condition and circumscription of *Acrodictys,* and a refinement of its taxonomy, was made by Baker *et al.* (2001b) with the establishment of a first segregate genus, *Junewangia* W.A. Baker & Morgan-Jones. In that publication, some account was given of the obviously significant discontinuities occurring between various clusters of species within *Acrodictys*. Among these is a small group of taxa in which the process of conidial detachment is radically different from that existing in the type species, *Acrodictys bambusicola* M.B. Ellis, and certain other closely similar taxa such as *A. atroapicula* C.J.K. Wang & B. Sutton and *A. elaeidicola* M.B. Ellis.

Specifically, the entities belonging to this cluster are characterized by rhexolytic conidial disarticulation, in contrast with the schizolytic process typical of *Acrodictys sensu stricto*. A treatment of three species exemplifying this difference, namely *Acrodictys erecta* (Ellis & Everh.) M.B. Ellis, *A. fimicola* M.B. Ellis & Gunnell, and *A. fuliginosa* B. Sutton, which Hughes (1979) reclassified in *Endophragmiella* B. Sutton [as *E. fuliginosa* (B. Sutton) S. Hughes], is contained herein and a second segregate genus is established in which to accommodate them. Following examination of the respective type specimens of *A. fimicola* and *A. sacchari* M.B. Ellis it has been determined that the two are conspecific. What differences exist between them are minor and merely reflective of the fact that the former was described from nature, whereas the latter is known only from pure culture. The binomial *Acrodictys sacchari*, published some ten years later, is, therefore, considered to be a facultative synonym of *Acrodictys fimicola*. Likewise, it appears, as already noted by Whitton *et al.* (2000) and Baker *et al.* (2001b), that *Acrodictys satwalekeri* D. Rao is a later name for *A. erecta*.

In addition to these taxa, *Acrodictys queenslandica* Matsush. is also reclassified in the new genus on the basis of the information contained in its type description and accompanying illustration [see Matsushima (1989)]. Although the dictyosporous conidia of this species are somewhat differently shaped from those of the three other taxa, having a flattened aspect in the sense of being broader than tall, the process of their formation and rhexolytic detachment appears to be identical. Moreover, conidiophore regenerative percurrent growth evidently occurs in exactly the same manner.

The anamorph presently known as *Acrodictys erecta*, which was originally placed in the genus *Mystrosporium* Corda [now considered a *nomen dubium* (see Hughes, 1958)], although bearing a superficial resemblance to *A. bambusicola* deviates from it in several significant ways beyond the method of conidium detachment mentioned above. The process of percurrent proliferation in relation to successive conidium production in the two differs appreciably and this is reflected in conidiophore morphology. Regenerative conidiophore growth in *A. erecta* is essentially identical to that typical of species of *Endophragmiella* B. Sutton, another genus in which conidia disarticulate rhexolytically, rather than being similar to that occurring in *Acrodictys sensu stricto*. Moreover, the pattern of conidial septation is also different. These same distinctions are also present in *A. fimicola*, and *A. fuliginosa.* In the case of the latter, some documentation of these distingishing characteristics has already been published by Hughes (1979).

In exemplifying the process whereby conidia are released by a circumscissile break in the periclinal wall a short distance below their basal delimiting septum, resulting in the conidiogenous cells becoming empty and open-ended, the three species of *Acrodictys* treated below bear similarity to the anamorphs currently classified in *Endophragmiella* and *Phragmocephala* E.W. Mason & S. Hughes [see Hughes (1979)]. Moreover, as mentioned above, sequential percurrent conidiophore proliferation, involving meristematic extension of the upper septum of the penultimate cell, and subsequent growth through and beyond the empty, cylindrical conidiogenous cell remnant, is a characteristic which they also have in common with *Endophragmiella*. A similar pattern of conidiophore secondary growth occurs in *Phragmocephala*. Interestingly, the rhexolytic break toward the conidiogenous cell apex occurs at a readily discernible, thin, lightly-pigmented zone or line of weakness just below the septum so that the tear in the wall is invariably more or less even and a circular fringe remains surrounding the base of the conidium. In this respect, these taxa closely resemble a number of *Endophragmiella* species, whereas in *Phragmocephala* the conidium-releasing fragmentation occurs rather irregularly, resulting in an unevenly torn appearance. They differ from *Endophragmiella* in having comparatively large, heavily-pigmented, dictyoseptate conidia.

Judging from the original accounts of their characteristics, a rhexolytic conidium detachment process also apparently occurs in several other somewhat similar anamorphs, some of whose taxonomy appears to be currently in need of review. Among these are *Kramasamuha sibika* Subram. & Vittal, the type species of the monotypic *Kramasamuha* Subram. & Vittal, and *Garnaudia elegans* Borowska, the type species of the monotypic *Garnaudia* Borowska. In the former, conidia were described (Subramanian and Vittal, 1973) as becoming detached by a break at a narrow, peg-like extension of the apex of the conidiogenous cells below the basal delimiting septum. Uncertainty was expressed as to the possible presence of a separating cell. In the latter, although Borowska (1977) makes no mention of the way in which conidia are released, the sometime presence of a basal marginal frill is, presumably, indicative of a tear occurring in the apex of the conidiogenous cells. The torn remains of the wall apparently may persist on the conidia or may disappear, a situation similar to that evident in some species of *Endophragmiella*, such as *E. valdiviana* (Speg.) S. Hughes. No percurrent proliferation through expended conidiogenous cells, which are discrete rather than integrated, occurs, however, in either of these genera and in this respect they differ significantly from both *Endophragmiella* and the new genus named herein. Two species of *Endophragmiella*, *E. cambrensis* M.B. Ellis and *E. tenera* Borowska, are similar in bearing discrete conidiogenous cells and also in lacking any secondary growth. As Hughes (1979) has already noted, these latter taxa are not, at present, satisfactorily classified and consideration of an alternative taxonomy in the context of reviewing the status of *Garnaudia* and *Kramasamuha* seems desirable. The type species of the latter genus seems unique and distinct but the former may well be an appropriate home in which to place the two above-mentioned species.

TAXONOMIC PART

Rhexoacrodictys W.A. Baker *et* Morgan-Jones gen. nov.

Coloniae effusae, velutinae vel pilosae, atro-brunneae ad atrae. Mycelium partim superficiale et partim immersum, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, cylindricis compositum. Conidiophora macronemata, mononemata, singula vel raro caespitosa, ex lateribus hypharum oriunda, erecta vel ascendentia, recta vel leniter flexuosa, laevia, parietibus crassis, cylindrica, saepe basi inflata, septata, atro-brunnea, sursum pallidiora, indeterminata, interdum cum proliferationes percurrentes. Cellulae conidiogenae in conidiophoris incorporatae, terminales, monoblasticae, pallide brunneae vel brunneae. Conidia holoblastica, solitaria, sicca, acrogena, obovata vel ovalia vel subsphaeroidea, septis transversalibus, longitudinalibus, et obliquus predita, laevia, brunnea ad atro brunnea, et cellula basali pallide brunnea, ad basim fimbriata, secessio rhexolytica.

Species typica: *Rhexoacrodictys erecta* (Ellis & Everh.) W.A. Baker & Morgan-Jones.

Rhexoacrodictys W.A. Baker & Morgan-Jones gen. nov.

Colonies effuse, velvety or hairy, dark brown to blackish, often somewhat thin and sparse. Mycelium partly superficial and partly immersed in the substrate, composed of branched, septate, pale brown to brown, smooth, cylindrical hyphae, occasionally with individual cells somewhat inflated, thicker-walled, and more heavily melanized. Conidiophores macronematous, mononematous, single or, more rarely, in a loose cluster of a few, arising laterally from the hyphae, usually from swollen cells, erect or ascending, straight or slightly flexuous, smooth, septate, thick-walled, cylindrical but often inflated toward the base, brown to dark brown, tapering slightly and paler distally, indeterminate, often elongating by regenerative, terminal, percurrent growth originating from the septum immediately subtending the previous conidiogenous locus. Conidiogenous cells integrated, terminal, monoblastic, mid brown, with or without a thin, narrow, circumscissile, barely-pigmented dehiscence zone at the extreme apex just below the conidium-delimiting septum, or with such a zone immediately subtending. Conidia holoblastic, solitary, dry, acrogenous, obovate or oval or subspherical, transversely, longitudinally, and obliquely septate, sometimes with darkly-pigmented bands over the septa, smooth, brown to dark brown, often with a paler basal cell, bearing a small marginal frill, derived from the upper portion the conidiophore, or with a short, terminal, conidiophore cell remaining attached, seceding rhexolytically.

Rhexoacrodictys erecta (Ellis & Everh.) W.A. Baker & Morgan-Jones comb. nov. (Figure 1).

≡ *Mystrosporium erectum* Ellis & Everh., *J. Mycol.* 4:53, 1888.

≡ *Macrosporium erectum* (Ellis & Everh.) Pound & Clem., *Bull. Geol. Nat. Hist. Surv. Minn.* 9:657, 1896.

≡ *Acrodictys erecta* (Ellis & Everh.) M.B. Ellis, *Mycol. Pap.* 79:12, 1961.

≡ *Piricauda serendipita* R.T. Moore, *Rhodora* 61:104, 1959.

≡ *Acrodictys satwalekeri* D. Rao, *Curr. Sci.*, 5:117, 1970.

Colonies effuse, hairy, black, usually rather thin. Mycelium partly superficial to predominantly immersed in the substrate, composed of branched, septate, pale to mid brown, smooth, cylindrical, 2-4.5μm wide hyphae; with intercalary cells from which conidiophores arise often becoming inflated, thicker-walled and rather dark brown. Conidiophores macronematous, mononematous, single, solitary, or in a cluster of up to three arising in close proximity on the hyphae, erect, straight or somewhat flexuous, smooth, septate, with septa appreciably thinner than the periclinal wall, thick-walled, cylindrical, inflated toward a 5-7μm wide base, brown to dark brown, tapering slightly and paler toward a 3.5-5μm wide distal portion, with a narrow, unpigmented, annular zone immediately subtending the septum delimiting the terminal cell and sometimes the penultimate cell, indeterminate, often elongating, usually once or twice, by regenerative, percurrent growth through a torn, open-ended apex following each conidial detachment, mostly up to 65μm long. Conidiogenous cells integrated, terminal, monoblastic, pale brown, becoming detached with the conidia by a split at a circumscissile, immediately subtending, dehiscence zone. Conidia holoblastic, solitary, dry, acrogenous, obovate or, rarely, subspherical, dictyosporous, with many predominantly oblique septa, thick-walled, smooth, brown to blackish brown, darker in the upper reaches when mature, with a short, pale, truncate conidiogenous cell bearing a marginal frill remaining attached as a protuberant basal element, 24-39 × 15-29μm in size, seceding rhexolytically.

Plurivorous, mainly on poaceous hosts or overgrowing plant-associated fungal colonies; cosmopolitan.

Collections examined: on *Zea mays* L., Pointe à la Hache, Louisiana, U.S.A., 9 December 1886, A.B. Langlois, No. 862, BPI 445573, holotype; on old corn stalks (*Zea mays* L.) in moist chamber, Iowa City, September 1951, G.W. Martin 6454a, ISC 384621 [holotype of *Piricauda serendipita* R.T. Moore]; on *Arundo donax* L., Botanical Gardens, Caracas, Venezuela,

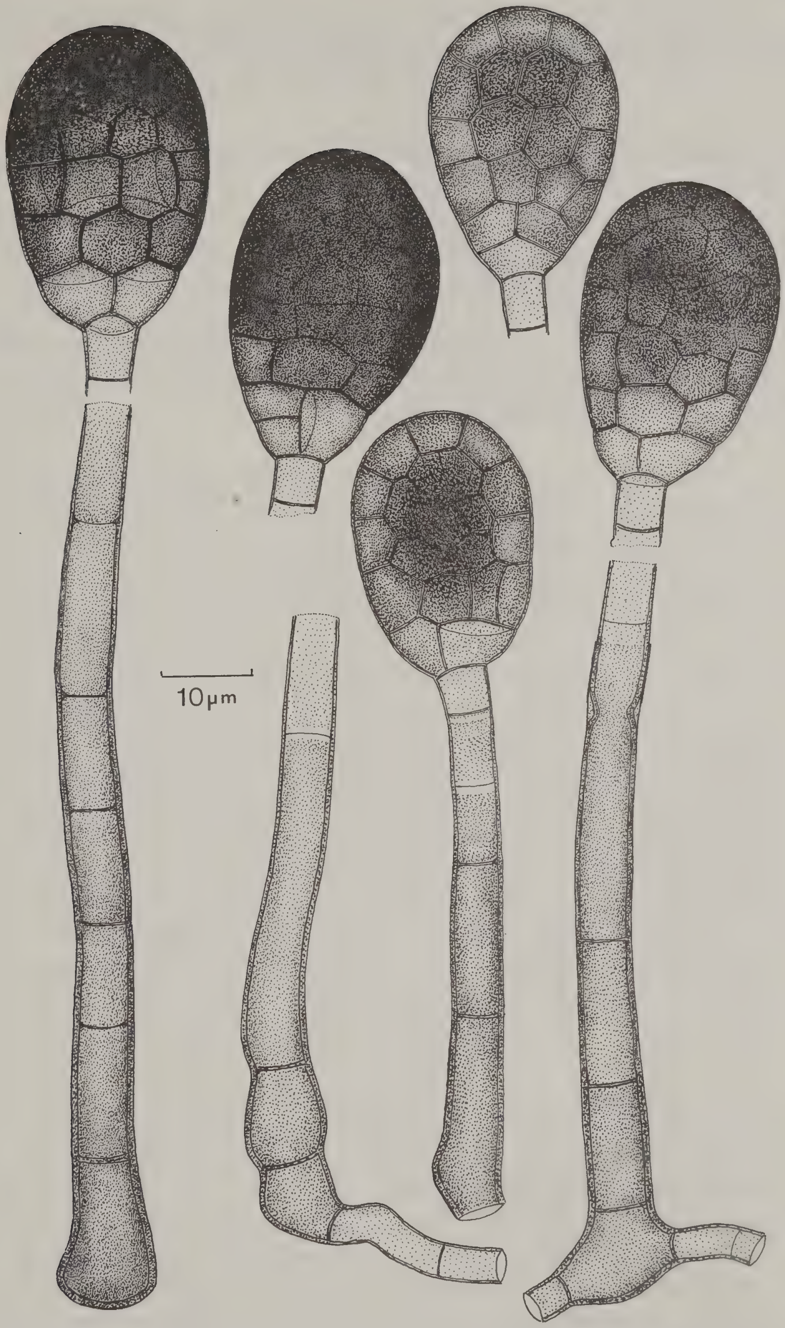

FIGURE 1. *Rhexoacrodictys erecta*. Conidiophores and conidia.

July 1958, R.W.G. Dennis, IMI 74757; on dead twig, Dullstroom District, Transvaal, South Africa, September 1983, H.M. Smith, AUA.

Rhexoacrodictys erecta appears to have a widespread geographical distribution. It has been collected in Japan on culms of *Saccharum officinarum* L. (Anon., 1975) and on dead bark of *Fagus crenata* Blume (Matsushima, 1975). Rao (1970) encountered it on old, unidentified stems in India [as *Acrodictys satwalekeri*] and there also exists a record of it from that country on dead stalks of *Zea mays* L. and overgrowing conidiophores of *Sporoschisma saccardoi* E.W. Mason & M.B. Ellis (Sharma and Munjal, 1979). Matsushima (1987) reported its occurrence on rotten stems of *Bambusa multiplex* Raeusch. in Taiwan.

Diversity of host substrate and an evident appreciable variation in conidium shape and size has given rise to the question of whether or not more than one species may be represented in the collections made to date and determined to be *R. erecta* [as *A. erecta* or *A. satwalekeri*]. In the case of the material on dead twigs from South Africa cited above, as noted by Sinclair (1990), conidial dimensions are considerably different from those of specimens originating from poaceous hosts. In this specimen conidia have a size range of 25-31 × 21-29μm, their length/width ratio giving a subspherical rather than a broadly obovate shape, as appears to be typical of this species when growing on maize [corn]. Interestingly, however, the conidia of a collection on *Zea mays* made in India [see Sharma and Munjal (loc. cit.)] were reported to be up to 28μm wide. The conidia in the type specimen, in contrast, never exceed 22μm in width. In naming a preceding Indian collection as a separate species, *Acrodictys satwalekeri*, Rao (loc. cit.) gave emphasis to the matter of difference in dimensions but it is now abundantly apparent that *R. erecta* is quite variable with regard to conidial size. There does not appear to be sufficient discontinuity among collections in this respect to warrant the recognition of separate taxa.

It is, perhaps, surprising that the presence of a readily-discernible, narrow, ring-like, lightly pigmented zone of dehiscence below the terminal conidiophore septum, a conservative feature which is now considered taxonomically valuable and phylogenetically informative, was not mentioned by a number of mycologists, such as Ellis (1961) and Matsushima (1975, 1987), during the course of providing modern descriptions of this anamorph. Interestingly, Moore (1959) makes mention, in his Latin diagnosis of *Piricauda serendipita*, with reference to the conidia, that “et solutione cellulae penultimae conidiophori disjuncta” and, in a caption to a photographic illustration of the taxon, noted the wall of the penultimate conidiophore cell to be partially dissolved. He appears to be the only author to previously document this significant characteristic.

With reference to percurrent conidiophore proliferation in *R. erecta* one other feature needs mentioning and that concerns septation. Following regenerative growth, two secondary septa are usually laid down in the extended portion above the level of the torn remnant of the penultimate conidiophore cell. The upper of these delimits the succeeding conidiogenous cell and thereby ultimately becomes the basal cell of the next detached conidium. The subtending septum may then give rise to a subsequent proliferation in a similar fashion to that occurring in *Endophragmiella pallescens* B. Sutton [see diagrammatic representation by Hughes (1979)].

Rhexoacrodictys fimicola (M.B. Ellis & Gunnell) W.A. Baker & Morgan-Jones comb. nov. (Figures 2 & 3).

≡ *Acrodictys fimicola* M.B. Ellis & Gunnell, *Mycol. Pap.*79:10, 1961.

= *Acrodictys sacchari* M.B. Ellis, *Mycol. Pap.* 125:6, 1971.

Colonies effuse, hairy, dark brown to black, often somewhat dense. Mycelium partly superficial to partly immersed in the substrate, composed of branched, septate, pale to mid brown, smooth, cylindrical, 2-4μm wide hyphae. Conidiophores macronematous, mononematous, single, solitary, erect, straight to somewhat flexuous, smooth, septate, with septa appreciably thinner than the periclinal wall, especially where formed secondarily in percurrently proliferated portions, thick-walled, cylindrical, inflated toward a 5-7μm wide base, mid brown to brown, tapering very slightly toward a 3-4.5μm distal portion, with a narrow, unpigmented, annular zone immediately subtending the conidium-delimiting septum and that delimiting the terminal cell, indeterminate, often elongating usually once or, more rarely, several times, by regenerative, percurrent growth through a torn, open-ended apex following each conidial detachment, mostly up to 75μm long. Conidiogenous cells integrated, terminal, monoblastic, pale brown, with a narrow, ring-like, sub-hyaline, appreciably thinner-walled zone at the extreme apex, sometimes disarticulating with the conidia by a circumscissile split below its delimiting septum. Conidia holoblastic, solitary, dry, acrogenous, broadly oval to subglobose or somewhat oblong, dictyosporous, transversely, longitudinally and obliquely septate, with readily-disernable septal pores, when young slightly constricted at the septa but becoming less so at maturity, thick-walled, smooth, mid brown to blackish brown, more or less evenly pigmented, truncate at the base and bearing a marginal frill or with a conidiogenous cell remaining attached as a protuberant basal element, 16-30 × 8-20μm in size, seceding rhexolytically.

Plurivorous; cosmopolitan.

Collections examined: on *Bambusa vulgaris* Schrad., Njala (Kori), Sierra Leone, November 1952, F.C. Deighton, IMI 51635b; on elephant dung, Perak, Malaya, September 1958, A.H.S. Onions, IMI 76413, holotype; dried culture derived from an isolation from *Saccharum officinarum* L., Mandeville, Sugar Research Department, Jamaica, February 1968, B. Hogg, IMI 131716 [holotype of *Acrodictys sacchari* M.B. Ellis].

In addition to the above-cited specimens, several further collections of this species have been made. It was reported on decaying leaves of *Argyroxiphium sandwicense* DC. in Hawaii (Raabe *et al.,* 1981) and there are two records of its occurrence in Cuba, on an unidentified dead branch and on a dead, rotten trunk, respectively (Holubová-Jechová and Mercado, 1984; Holubová-Jechová and Mercado, 1986). Matsushima (1985) described an isolate [as *A. sacchari*] from rotten *Eucalyptus globulosus* St.-Lag. [as *E. globulosa*] leaves collected in Tasmania which bears chlamydospores resembling those of *Trichocladium opacum* (Corda) Hughes, in addition to normal conidia. More recently, Whitton *et al.* (loc. cit.) encountered *R. fimicola* on decaying leaves of a species of *Pandanus* S. Parkinson in Malaysia.

When grown in axenic culture the morphology of this taxon differs somewhat from the form existing in nature, indicating the presence of a substantial degree of phenotypic plasticity. In the isolate on which Ellis (1971) based the binomial *Acrodictys sacchari* the conidiophores are shorter, more flexuous, and less well differentiated than those produced on natural substrates. Moreover, the conidia are more variable in size and shape and are somewhat constricted at the septa over a longer developmental period. Interestingly, in culture, when conidiophore percurrent proliferation occurs a displaced conidium is frequently seen lying sideways proximal to the locus of the rhexolytic tear [see Figure 3]. Similar differences in conidial characteristics apparently existed in the isolate described by Matsushima (1985), where they were said to be “more or less persistent to conidiophores” but no conidiophore proliferation was reported. A further indication of variability was provided by Whitton *et al.* (loc. cit.) when they noted conidia in their collection to differ from those typical of the species in having fewer

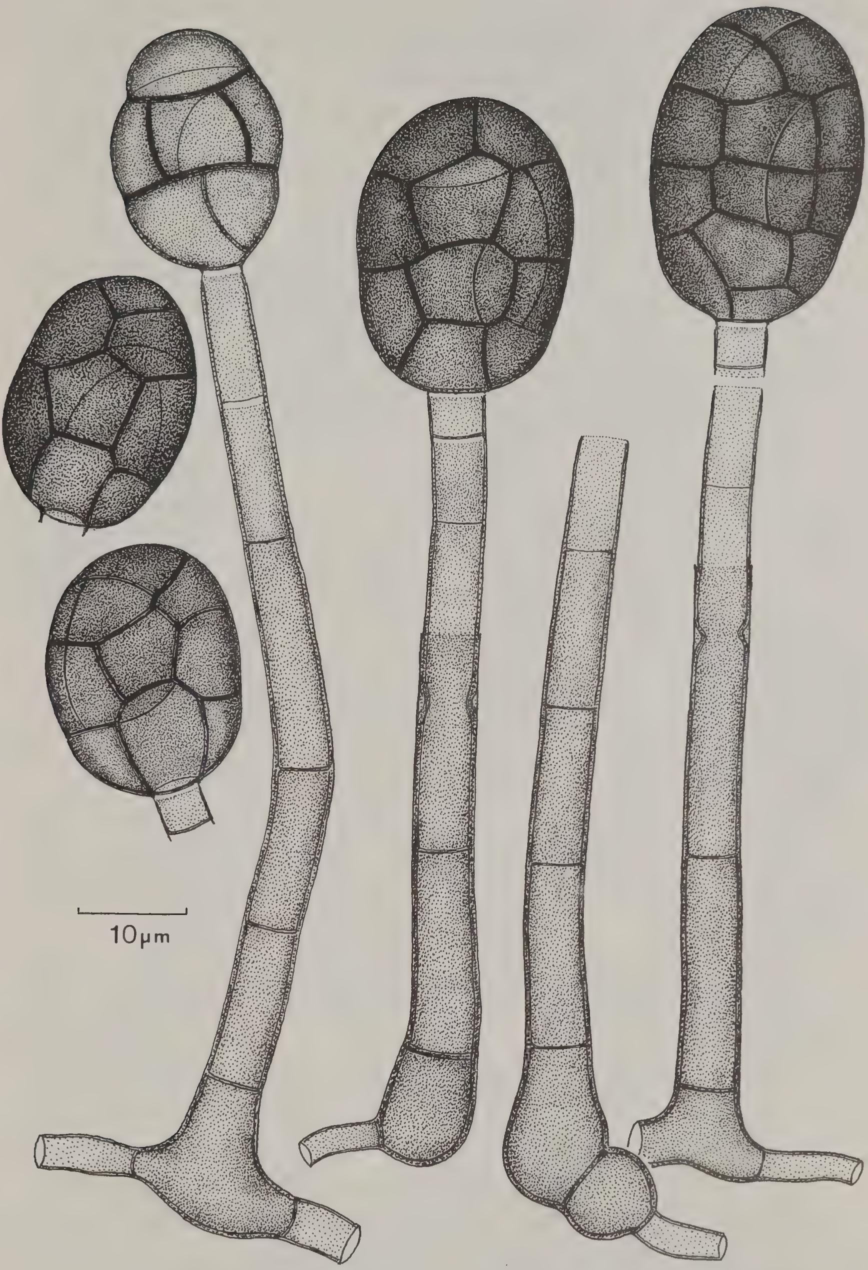

FIGURE 2. *Rhexoacrodictys fimicola*. Conidiophores and conidia [from holotype].

internal septa and none that are oblique. It is evident that *R. fimicola* has a similar degree of morphological and dimensional variation to that existing in *R. erecta*, as mentioned above, particularly when collections made from nature and those obtained in pure culture are compared. It should be added, however, that although the isolates to which the name *A. sacchari* has been applied differ somewhat from the natural form there can be little doubt of their conspecificity with *R. fimicola*.

As in the case of *R. erecta*, it is somewhat surprising that no mention of the rhexolytic process of conidial detachment, nor the presence of a basal marginal frill, has hitherto been made by mycologists who have collected and/or studied this taxon. This characteristic feature is particularly interesting in *R. fimicola* since the exact position at which the circumcissile tear in the conidiophore periclinal wall which releases each conidium occurs can vary. The irregularity in this regard appears to be unique to this species. It is apparent that two narrow zones of dehiscence exist; one immediately below the basal septum of the conidium and the other closely subtending the septum delimiting the terminal conidiophore cell [the conidiogenous cell]. The tear which releases the conidium can occur at either of these positions resulting in the creation of a basal, marginal frill or in the short, cylindrical conidiogenous cell remaining attached. Because of the shape of the conidia, and particularly the rotundity of their base, where detachment occurs by a tear closely below their basal septum the marginal frill is not always immediately obvious but is, nevertheless, readily discernable if looked for.

Another characteristic of this taxon in culture is apparently the formation of chains of thick-walled, brown, torulose chlamydospore-like cells. These were reported by both Ellis (1971) and, as noted above, Matsushima (1985).

Rhexoacrodictys fuliginosa (B. Sutton) W.A. Baker & Morgan-Jones comb. nov. (Figure 4).

≡ *Acrodictys fuliginosa* B. Sutton, *Can. J. Bot.* 47:853, 1969.

≡ *Endophragmiella fuliginosa* (B. Sutton) S. Hughes, *N. Z. J. Bot.* 17:150, 1979.

Colonies effuse, hairy, black, often somewhat sparse. Mycelium partly superficial to predominantly immersed in the substrate, composed of branched, septate, pale to mid brown, smooth, cylindrical, 2-5μm wide

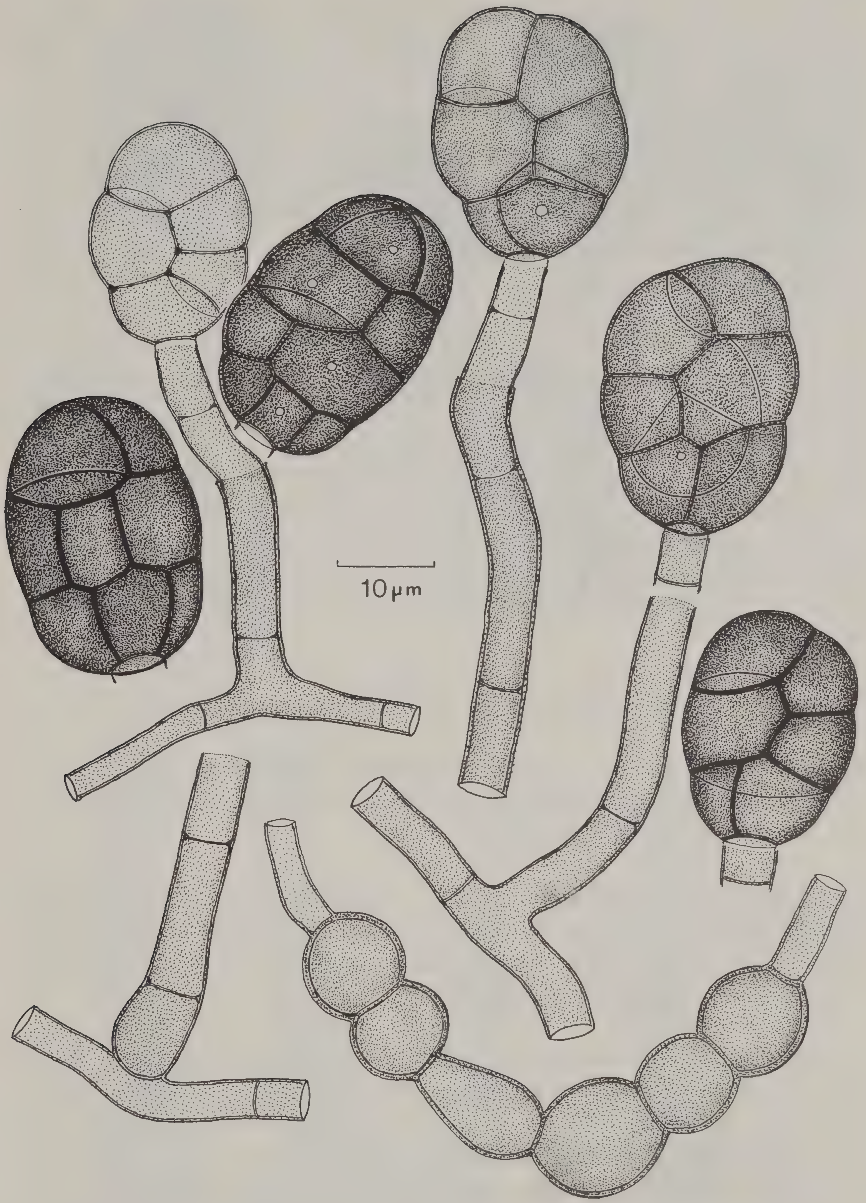

FIGURE 3. *Rhexoacrodictys fimicola*. Conidiophores and conidia in culture [from holotype of *Acrodictys sacchari*].

hyphae. Conidiophores macronematous, mononematous, single, solitary, erect, straight to somewhat flexuous, smooth, septate, with septa appreciably thinner than the periclinal wall, thick-walled, cylindrical, inflated toward a somewhat bulbous 5-8μm wide base, mid brown to brown, tapering very slightly toward a 3-4.5μm distal portion, with a narrow, unpigmented, annular zone immediately subtending the conidium-delimiting septum and sometimes that delimiting the terminal cell, particularly following proliferation, indeterminate, often elongating, usually one to three times, by regenerative, percurrent growth through a torn, open-ended apex following each conidial detachment, with the proliferated portion sometimes assuming a narrowly ampulliform aspect, mostly up to 80μm long. Conidiogenous cells integrated, terminal, monoblastic, pale brown, with a narrow, ring-like, sub-hyaline, appreciably thinner-walled zone at the extreme apex. Conidia holoblastic, solitary, dry, acrogenous, obovate, dictyosporous, usually with three or four transverse septa and several longitudinal or oblique septa, thick-walled, with the septa, particularly in the upper reaches, often obscured by overlaying darkly-pigmented bands, smooth, brown to blackish brown, darker in the upper reaches when mature, with a short, pale, truncate basal cell bearing a pronounced, substantial marginal frill, 17-27 × 11-16μm in size, seceding rhexolytically.

On decaying wood and bark; cosmopolitan.

Collection examined: on decaying bark of *Populus tremuloides* Michx., Clearsand Creek, Candle Lake, Saskatchewan, Canada, 1 August 1967, B.C. Sutton 2295, BPI 71773, holotype.

This species is known to occur on a variety of host trees and is known mainly from a number of specimens obtained in Canada (Sutton, 1969; Hughes, 1979) and New Zealand (Hughes, 1978). Matsushima (1975) reported two collectons from Japan.

In the publication in which *A. fuliginosa* and *A. excentrica* B. Sutton were described, Sutton (1969) alluded to the fact that within the genus *Acrodictys* as circumscribed at that time the range of conidial morphology was considerable and it was further noted that the generic concept had been repeatedly extended. Given the further differences in the process by which conidia become detached and resultant variation in conidiophore morphology and growth pattern, it has become increasingly apparent that *Acrodictys* contains heterogeneous elements.

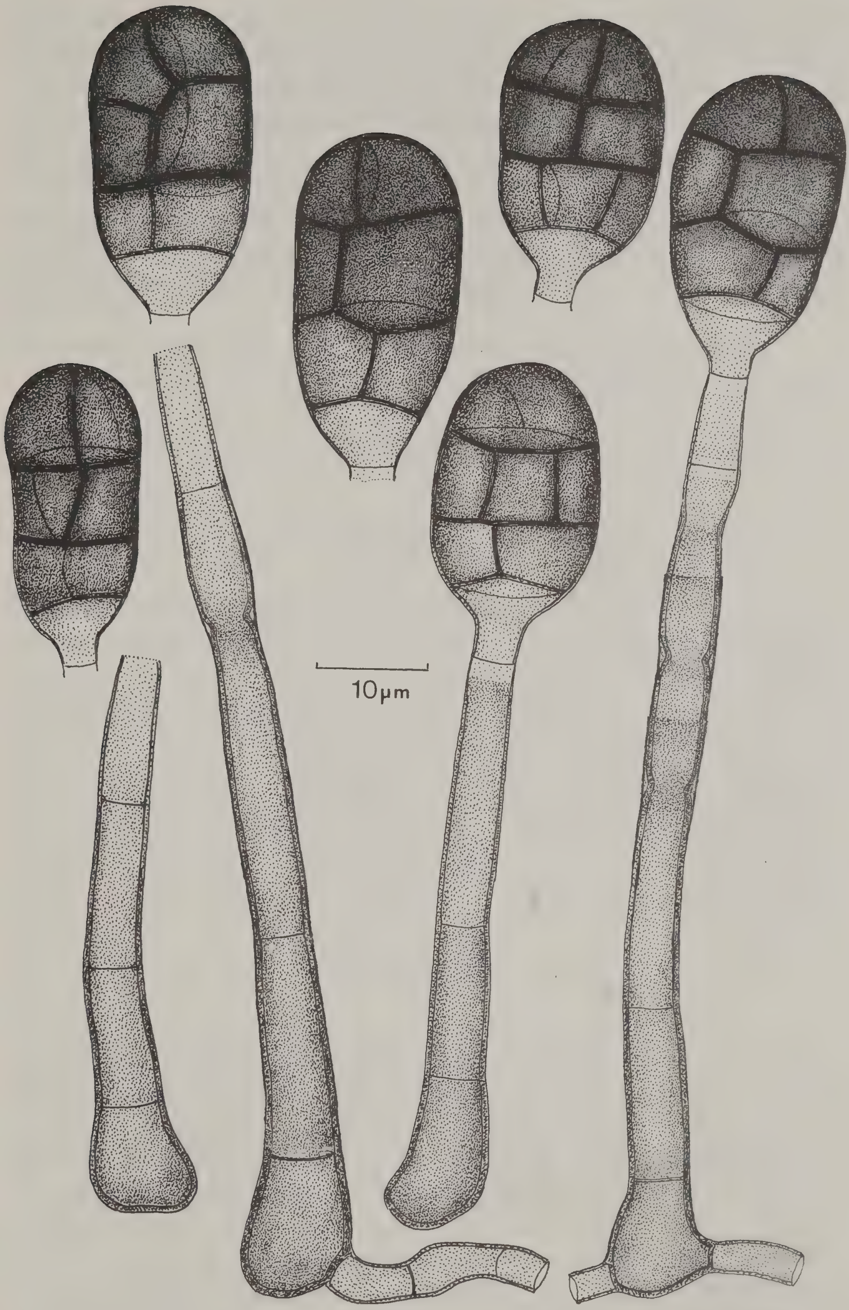

FIGURE 4. *Rhexoacrodictys fuliginosa*. Conidiophores and conidia.

In reaching the decision to reclassify *R. fuliginosa* in *Endophragmiella* Hughes (1979) laid primary emphasis on the method of conidium secession, giving the size, pigmentation, and extent of conidial septation secondary consideration. Interestingly, the alternative option of describing a new form-genus in which to accommodate this taxon was raised. In view of the fact that there exist other species in which conidia detach rhexolytically and are structurally more complex in terms of degree of septation, and are more densely pigmented, namely *R. erecta* and *R. fimicola,* the case for the establishment of the novel genus described herein is strengthened.

Rhexoacrodictys queenslandica (Matsush.) W.A. Baker & Morgan-Jones comb. nov.

≡ *Acrodictys queenslandica* Matsush., *Mats. Mycol. Mem.* 6:4 1989.

[For description and illustration see Matsushima (1989)]

In all essential characteristics, this species fits perfectly in *Rhexoacrodictys*. The morphology and regenerative percurrent growth of its conidiophores are typical of the genus, as is the fact that their transverse septa are thinner than the periclinal wall. With regard to conidium detachment *R. queenslandica* shares the characteristic in common with *R. fimicola* of the rhexolytic break occurring either immediately below the basal septum or below that delimiting the terminal conidiophore cell. Similarly, detached conidia become displaced, but may remain oriented laterally close to the level of the releasing tear, following percurrent proliferation. As noted above, this taxon is readily distinguishable by the shape of its conidia.

DISCUSSION

As was discussed by Hughes (1971), detachment of propagules by rhexolytic fracture, and subsequent regenerative percurrent proliferation involving the basal septum of the broken mother cell, is a phenomenon which occurs in a number of distantly-related fungi and in other organisms such as mosses, where gametophytic gemmae are commonly released in a similar fashion. The presence of a thin, narrow, annular zone in the periclinal wall, at which the split which releases the propagules occurs, is also, interestingly, a feature exemplified by various unrelated entities. Some mosses, for instance, also possess this characteristic. Because of the functionally specialized nature of this peculiarity it must, surely, continue to be considered phylogenetically informative. Within the genus *Rhexoacrodictys* it is interesting to note that the position at which the rhexolytic break occurs varies among and between species. In *R. erecta* the tear always occurs below the septum delimiting the short, terminal conidiophore cell whereas in *R. fuliginosa* this always occurs below the basal septum of the conidium. In contrast, both *R. fimicola* and *R. queenslandica* are irregular in this regard. Another aspect which should also be noted is the fact that the conidium-releasing break in *R. fimicola*, where it occurs below the basal septum, is closely proximal to it whereas in *R. fuliginosa* the position of the break is a short distance away from the septum. Consequently the size of the marginal frill differs.

As alluded to previously (Baker *et al.,* 2001b), the status of a number of other species of *Acrodictys* requires reconsideration. Among these are *Acrodictys excentrica*, which Hughes (1979) reclassified in *Arachnophora* Hennebert [as *A. excentrica* (B. Sutton) S. Hughes] and Castañeda and Kendrick (1990) in *Digitoramispora* R.F.Castañeda & W.B. Kendr. [as *D. excentrica* (B. Sutton) R.F. Castañeda & W.B. Kendr.], *Acrodictys septosporioides* Matsush., and *Acrodictys triarmatus* Whitton, McKenzie & K.D. Hyde. In having conidia bearing a basal frill, indicative of rhexolytic detachment, *A. excentrica* resembles *Rhexoacrodictys* and it might well be appropriate to transfer it to this genus. Interestingly, its conidia have similar dark bands over the septa to those occurring in *R. fuliginosa*. A determination in this regard is, however, being deferred until such time as its type specimen is examined. Although *Arachnophora,* as typified by *A. fagicola* Hennebert, is characterized by having rhexolytic conidial disarticulation, the unique morphology of its conidia brings into question the suitability of placing *A. excentrica* within it. As noted earlier (Baker *et al.,* 2001b), the classification of *A. excentrica* in *Digitoramispora* seems also inappropriate since the conidia of the type species of that genus, *D. caribensis* R.F. Castañeda & W.B. Kendr., apparently detach schizolytically and, consequently, do not bear a basal frill. In reaching the decision to classify *A. excentrica* in *Arachnophora*, rather than in *Acrodictys*, Hughes (1979) placed strong emphasis on the morphology of its conidia, which are lobed with satellite cells rather than being truly dictyoseptate. In this species each conidium has a two- or three-celled central axis bearing lateral or obliquely orientated peripheral cells. He also noted that percurrent conidiophore proliferation in *A. excentrica* is identical in type to that occurring in both *Arachnophora* and *Endophragmiella*.

In any consideration of the possible suitability of classifying *A. excentrica* in *Rhexoacrodictys* the matter of conidium morphology divergence will clearly need to be further revisited. It might well be that *A. excentrica*, despite exemplifying exactly the same process of conidial detachment and subsequent conidiophore proliferation, would not be any more satisfactorily accommodated in *Rhexoacrodictys* than it has been in *Acrodictys*. A resolution of this taxonomic dilemma may require the establishment of a further new segregate genus in which to place it. Interestingly, in this context, the status of *A. triarmatus* will need reviewing. This species bears similarity to *A. excentrica* in having atypically configured conidial cells arranged in columns which sometimes become lobed. In the original description of this taxon Whitton *et al.* (loc. cit.) note that a "conical and protuberant portion of the conidiogenous cell" often remains attached to the conidium base but no mention is made of the precise method of conidial disarticulation. If this occurs rhexolytically *A. triarmatus* and *A. excentrica* must not only continue to be regarded as being congeneric but, moreover, a justification for their classification separately from those taxa placed in *Rhexoacrodictys* herein is strengthened.

ACKNOWLEDGMENTS

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HALOSARPHEIA HETEROGUTTULATA: ANAMORPH AND REPORT FROM THE NORTHERN HEMISPHERE

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ABSTRACT

Halosarpheia heteroguttulata is reported for the first time from North America. This freshwater ascomycete was cultured from woody debris collected from the Fakahatchee Strand Preserve State Park, Florida USA. A *Trichocladium* anamorph is reported for *H. heteroguttulata*. The teleomorph and anamorph are illustrated and morphological similarities of the anamorph to *T. constrictum* are discussed.

KEY WORDS: freshwater, Halosphaeriales, hyphomycetes, *Trichocladium*

INTRODUCTION

Halosarpheia heteroguttulata S.W. Wong, K.D. Hyde & E.B.G. Jones is a freshwater ascomycete (Halosphaeriales) with appendaged bicelled ascospores that have a distinctive pattern of oil guttulation; the apical cell contains one or a few large guttules, the basal cell contains only small guttules (Fig. 5). This guttulation pattern is unique among the species currently circumscribed within the polyphyletic genus *Halosarpheia* (Anderson *et al.* 2001)

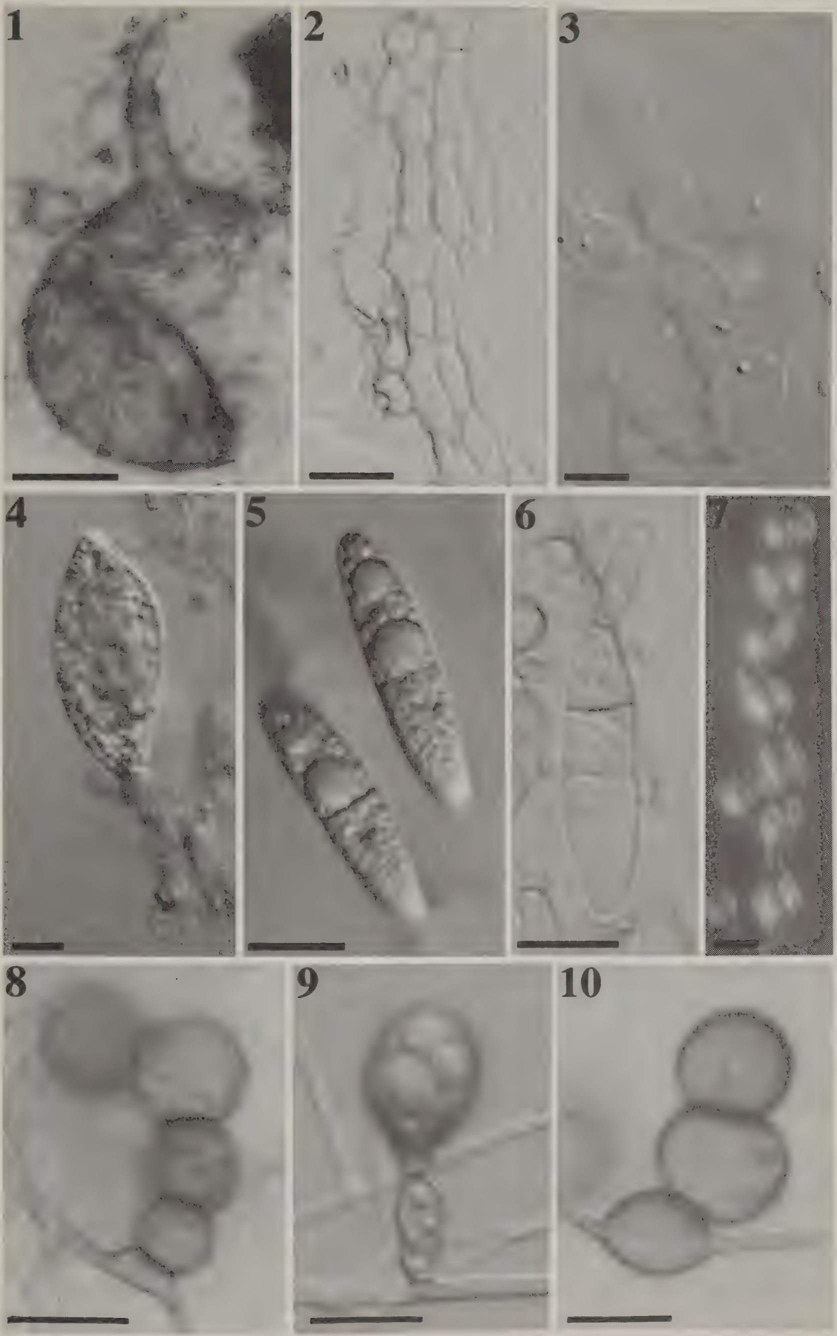
This species has been reported from Australia, Brunei, Hong Kong, Mauritius, Philippines, and South Africa (Wong *et al.* 1998, Hyde *et al.* 1999). In this paper, a collection of *H. heteroguttulata* from Florida, USA is reported (Figs. 1-6) and its *Trichocladium*-like anamorph is illustrated (Figs. 7-10).

MATERIALS AND METHODS

Woody debris collected from freshwater in the Fakahatchee Strand Preserve State Park, Collier County, Florida was incubated in plastic containers at 24 C until ascomata were observed. Single ascospore isolates were prepared by removing ascomata from the substrate, crushing them between two sterile needles and spreading the contents of the centrum over the surface of antibiotic water agar plates (AWA; 18 g agar, 500 mg each Streptomycin Sulfate and Penicillin G per liter distilled water). Plates were incubated at room temperature (24 C) for 48 h then, under observation with a dissecting microscope, single germinated ascospores were transferred to yeast peptone soluble starch agar plates (YPSS; 4g yeast extract, 15 g soluble starch, 1 g K_2HPO_4, 0.5 g $MgSO_4{\bullet}7H_2O$, and 18 g agar per L distilled water). Four separate single ascospore derived cultures were obtained (A108-7A to -7D). Slide mounts were prepared from all four cultures and examined for production of an anamorphic state using light microscopy.

The single ascospore derived culture A108-7D was grown in 50 mL liquid peptone, yeast extract, glucose media (PYG; 1.25 g peptone, 1.25 g yeast extract, and 3 g D-glucose per L distilled water) with dried alfalfa stems in a 125 mL Erlenmeyer flask for one month. Colonized alfalfa stems were removed and placed in a sterile glass Petri dish containing moist filter paper, sealed with Parafilm, and incubated at ambient room conditions (24 C and fluorescent lights) until fruiting occurred. Both ascomata and conidia were produced by isolate A108-7D on alfalfa. Ascospores and conidia were removed from the alfalfa and spread with a sterile needle over AWA plates. A small amount of sterile distilled water was poured onto the plates to aid in dispersal of the spores. Separate plates were prepared for ascospore and conidium isolations. Incubation and single spore isolation were as described above. Only single spores that were clearly solitary and identifiable as conidia or ascospores were used. These isolates were grown on YPSS with balsa and observed for production of anamorphic and teleomorphic states. Three cultures derived from ascospores and three from conidia were maintained. The single spore isolation process was repeated from ascomata and conidia produced in the first iteration to test reproducibility of results.

Figs. 1-6. *Halosarpheia heteroguttulata.* **1.** Squash mount of ascoma (bar = 100 µm). **2.** Midsection of ascoma showing wall layers. **3.** Catenophyses. **4.** Immature ascus. **5.** Ascospores illustrating the guttulation pattern unique to this species, appendages not illustrated. **6.** Germinated ascospore with a second septation on the growing half of the spore. **Figs. 7-10.** *Trichocladium*-like anamorph of *H. heteroguttulata* illustrating the globose nature of the cells composing the conidia as well as variation in cell number. Measure bars = 10 µm unless otherwise noted.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RESULTS

All four single ascospore derived cultures of A108-7 (A-D) produced the same anamorphic state in culture. Conidia were readily observed under the microscope by removing agar and hyphae from visibly darker areas of the cultures and mounting them on slides in water.

Verification of this anamorph/teleomorph connection was performed using A108-7D by producing sub-cultures derived from single ascospores or conidia. Cultures of single ascospore or single conidium origin produced both *H. heteroguttulata* ascomata and *Trichocladium*-like conidia in 10 of 12 cultures. The remaining two cultures, both of single ascospore origin, only produced the anamorphic state.

Halosarpheia heteroguttulata S.W. Wong, K.D. Hyde & E.B.G. Jones, Can. J. Bot. 76: 1857-1862. 1998. Figs. 1-6
Illustrations: Wong *et al.* 1998, Figs. 1-16 and Hyde *et al.* 1999, Figs. 100-107.
Ascomata 120-144 μm in diameter, globose, superficial to slightly immersed, brown, membranous (Fig. 1). Peridium 14-19 μm thick, composed of several layers of elongate, thin-walled, lightly pigmented, pseudoparenchyma (Fig. 2). Neck 40-48 μm long and 24 μm wide, light brown at tip (Fig. 1). Catenophyses present (Fig. 3). Ascus 44 x 18 μm (n=1, immature), early deliquescing (Fig. 4), lacking an apical apparatus. Ascospores (Fig. 5) 26-34 (-36) x 6-8 μm, ellipsoidal, hyaline, one-septate, one cell containing 1-2 large guttules, the other with numerous small guttules, with bipolar unfurling appendages. Ascospores develop a second septum in the upper cell during germination (Fig. 6). Colonies on PYG agar black, brownish-black in reverse, with no diffusible pigments; hyphal growth compact, mostly submersed in media.
Anamorph:—*Trichocladium* sp. Conidia of non-branching chains of brown globose cells formed directly on the hyphae, most often on distinctly swollen dematiaceous hyphal cells on otherwise hyaline hyphae (Figs. 7-10); conidia 1-7 cells long, ranging in length from 7-31 μm. Apical cell of the conidial chain (diameter 9-14 μm) is not consistently the largest; basal cell 4-10 μm in diameter. Hyphae and conidia are submerged in YPSS agar cultures.

Specimen examined:— U.S.A. FLORIDA: Fakahatchee Strand Preserve State Park, Collier County, latitude 26.00028, longitude -81.41667, on woody debris, 13 May 1993, *J.L. Crane* A-108-7 (ILL).

DISCUSSION

Collection A108-7 from Florida, USA, agrees with the protologue of *H. heteroguttulata* in most aspects, differing primarily in ascospore width. Ascospore width for this species is reported as 9-17.5 µm (Wong *et al.* 1998) and 12.5-17.5 µm (Wong *et al.* 1998, Hyde *et al.* 1999). The spores we observed were 6-8 µm wide, which is narrower than either earlier report. We consider it prossible that the difference in ascospore width represents natural variation between individuals of geographically distant populations; therefore, identification of A108-7 as *H. heteroguttulata* is appropriate. This constitutes the first report of *H. heteroguttulata* from North America.

The anamorphic state was consistently produced by isolates of both single conidium and single ascospore origin. This anamorph agrees most closely with the genus *Trichocladium,* notably *T. constrictum* Schmidt as described by Schmidt (1974, 1985) and illustrated by Schmidt (1974) and Koch (1982). *Trichocladium constrictum* is described with the apical conidal cell 13-20 µm in diameter and conidia 25-43 µm long and conidia reddish-brown or dark brown in color. Koch (1982) provides the second detailed report of this species based on an isolate from Sri Lanka with conidia 12-16 µm x 40-80 µm. Both Schmidt and Koch emphasize strong constrictions at the septa. Isolate A108-7 differs from previous reports and direct observation of the type material of *T. constrictum* in having conidia that are shorter, 7-31 µm, and having smaller apical cells, 9-14 µm. Whereas the cells of *T. constrictum* conidia clearly and consistently decrease in size from tip to base, the cells of A108-7 conidia demonstrate this pattern infrequently (Figs. 8 and 10). Also, the conidia of A108-7 cannot be described accurately as reddish in color relative to the type material of *T. constrictum.*

T. constrictum has not been reported from fresh water; however, it has been observed over a range of salinity from salt water (Grasso *et al.* 1997, Koch 1982, Koch and Petersen 1996, Schmidt 1974) to water only slightly saltier than freshwater (Schmidt 1974). Isolate A108-7 was collected from freshwater. It is interesting to note, however, that the river it was collected from increases in salinity as it passes through Bald Cyprus/Royal Palm swamp to Mangrove swamp and approaches the Gulf of Mexico. Thus far, the teleomorph *H. heteroguttulata* has been reported only from freshwater habitats in the tropics and warm temperate areas.

Goh and Hyde (1999) provide a key to 18 species of *Trichocladium* in which A108-7 keys out to *T. lignincola* Schmidt (conidia 3-7 cells long, 25-32 µm x12-17 µm) based on diameter of the apical conidial cell. As illustrated by Schmidt (1974) and confirmed by direct observation of the type material, *T. lignincola* conidia are composed primarily of flattened cells with a lesser degree of constriction at the septa than either *A108-7 or T. constrictum*. Flattened cells were not observed for isolate A108-7. Therefore, we affirm that the anamorph reported here more strongly resembles *T. constrictum* than *T. lignincola*.

ACKNOWLEDGEMENTS

We offer our thanks to Dr. J. L. Crane for collecting the materials upon which this study is based. Dr. Kohlmeyer and Dr. Volkmann-Kohlmeyer are gratefully acknowledged for drawing our attention to the genus *Trichocladium*, providing otherwise unavailable literature, and making valuable suggestions in review of this manuscript. We are also grateful to M. Owen, Biologist at the Fakahatchee Strand Preserve State Park, for information about the collection site and B. F. Clegg for translation of literature. This research was possible due to funding from the National Science Foundation (NSF grant No. DEB 92-00885 and grant No. DEB 95-08992).

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MYCOTAXON

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A NEW VARIETY OF NITSCHKIA PARASITANS HYPERPARASITIC ON NECTRIA CINNABARINA FROM AMERICAN BEECH

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ABSTRACT

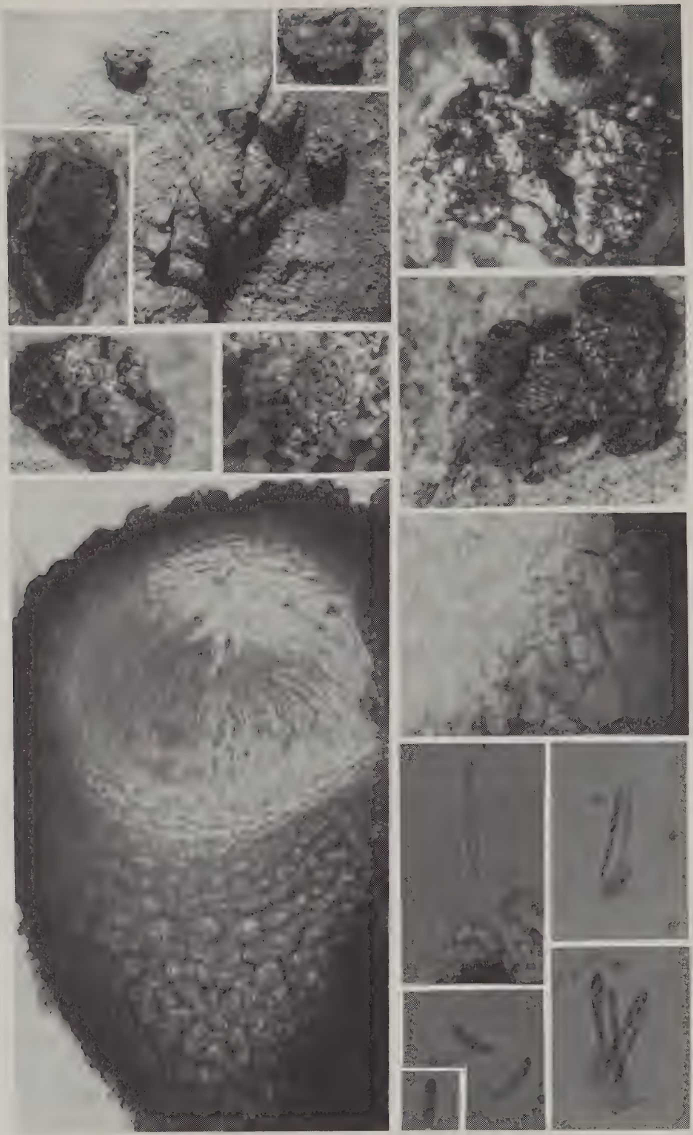
A new variety, *Nitschkia parasitans* var. *mijuskovicii* (Ascomycetes: Nitschkiaceae), is described from American beech (*Fagus grandifolia*) in Canada. Its hyperparasitic relationship with *Nectria cinnabarina* (anamorph: *Tubercularia vulgaris*) is also documented and illustrated.

Keywords : *Nitsckia parasitans* var. *mijuskovicii*, Ascomycota, biological control, *Fagus grandifolia*

INTRODUCTION

During a biodiversity study on mycobiota on American beech in Quebec, Canada, a new variety of *Nitschkia parasitans* var. *mijuskovicii* has been described. The fungus is a member of Coronophorales, a small order of ascomycetous microfungi containing the Nitschkiaceae. The family Nitschkiaceae was first monographed by Fitzpatrick (1923) and later revised by Nannfeldt (1975a , 1975b), who reduced the number of genera closely related to *Nitschkia*. According to Funk (1979) *Nitschkia* is characterized by species with turbinate ascocarps, clavate unitunicate asci, hyaline, allantoid ascospores, and unique "Munk" pores in the peridial cells. A "Quellkörper" in the apex of the ascoma is also very common in this genus.

Ellis and Ellis (1985) recognised four caulicolous *Nitschkia* species on *Fagus* in Europe. Among those: *N. brevispina* (Munk) Nannf. and *N. grevillei* (Rehm) Nannf. were associated with various pyrenomycetes; *N. cupularis* (Pers.) P. Karsten was found on dead branches; and *N. parasitans* (Schwein.) Nannf. grew on stromata of *Nectria cinnabarina* (Tode: Fr.) Fr. The new variety *N. parasitans* var. *mijuskovicii* is also hyperparasitic on *N. cinnabarina* on *Fagus grandifolia* Ehrh. in eastern North America, and on *Tilia cordata* Mill. in Central Europe. This is the first report of *N. parasitans* present on American beech, and it is the first record of such in North America (Farr et al. 1989).



Figures 2-12. *Nitschkia parasiticus* var. *mijuskovicii* on *Nectria cinnabarina* from *Fagus grandifolia* (Holotype : MT-NC07). 2. Nectria canker (bar = 400 µm) with partially necrotic (right upper) and fully necrotic stromata (left lower) caused by Nitschkia; 3. Ascomata of infected Nectria (arrow) growing on the periphery of necrotic stromata infected by Nitschkia (bar = 50 µm) . 4. Nitschkia ascomata (arrow) formed around necrotic stroma of Nectria (bar = 100 µm). 5 et 6. Clustered Nitschkia fructifications on an destroyed Nectria stroma (bar = 200 µm); 7. Ascoma stained in acid fuchsine, median longitudinal section showing Quelkorper (arrow) (bar = 20 µm). 8. Munk pores in outer wall of ascomata (arrows) (bar = 5 µm); 9-11. Asci (bar = 10 µm). 12. Mature ascospores (bar = 5 µm).

The Ecological Reserve

The study area is located in Muir's Wood ecological reserve (Figure 1), an American beech (*Fagus grandifolia.*) old-growth forest in Quebec, Canada. A more complete description of the vegetation and history of the Muir's Wood can be found in Brisson et al. (1992).

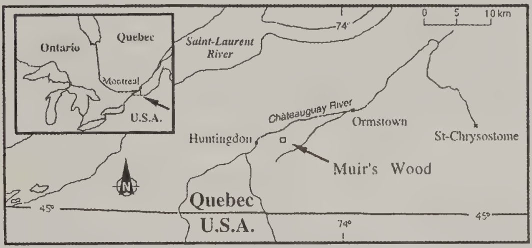

Ontario
Quebec
Montreal
U.S.A.
Saint-Laurent River
74°
0 5 10 km
Châteauguay River
Ormstown
Huntingdon
St-Chrysostome
Muir's Wood
N
45°
Quebec
U.S.A.
74°
45°

Figure 1. Geographical location of Muir's Wood old-growth forest in North America

Nitschkia parasitans (Schwein.) Nannfeldt in Svensk. Bot. Tidskr. 69: 3-4 (1975) var. ***mijuskovicii*** **VUJANOVIC** var. nova FIGURES 5-11

= ***Nitschkia fuckelii*** Nitschke, in Fuckel, Symb. Mycol. p.165 (1869)
= ***Nitschkia moravica*** Niessl in Paul, Verh. Natürforsch. Ver. Brunn 47: 139, 140 (1908)

Ascocarpia atra, erumpentia, agregata, turbinata, cupulato-colapsa, tuberculata, e pseudoparenchimata composita, 150-250 µm lata. 'Munk pores' et 'Quellkörper' praesentia. Asci clavati, breve stipitati, 8-spori, 35-65 x 5-10 µm. Ascosporae hyalinae, allantoidae, nonseptatae, guttulatae, 5-11 x 2-2.8 µm.

Ascomata erumpent, in small or large clusters, black, turbinate, collapsing cupulate, 150-250 µm diam, composed of an outer *textura angularis* wall, 20-40 µm diam, with thick walled brown cells possessing Munk pores, and an inner *textura prismatica* wall, up to 10 µm in diam, with thin-walled paler cells; apical papilla inconspicuous or absent.

Hymenium was stained in 0.02% acid fuchsin (AF+) aqueous solution, while the cells in the central epithecial region of the 'Quellkörper' were AF- (Figure 7). Liberated 'Quellkörper' cells in water considerably increased in size (mean : 10 x 8 µm) resulting in ascomata opening and liberating ascospores (Figure 13). Their position and forms become like paraphyses.

Asci clavate, unitunicate, short stalked, 8-spored, uni- to biseriate, apical wall thickened, 35-65 x 5-10 µm.

Ascospores hyaline, allantoid, nonseptate, with one droplet at each end, 5-11 x 2-2.8 µm.

Anamorph – unknown [Remarks: sometimes, hyaline microconidia (3-5 x 1-2 µm) have been observed in pycnidia found in the same pustule with the ascomata. Similar structures have reported for *Nitschkia molnarii*, as a possible microconidial state that was closely associated with ascomata (Funk 1979).]

Figure 13. 'Quellkörper' cells (arrows) liberated in water (bar = 10 µm)

Host species: *Nectria cinnabarina* (Tode:Fr.) Fr. on *Fagus grandifolia* and *Tilia cordata*

Known distribution: Canada and Austria.

HOLOTYPE: CANADA, Quebec, Muir's Wood ecological reserve, on living stroma of *Nectria cinnabarina* from branches of *Fagus grandifolia*. 12. IX. 1998, Vujanovic MT-NC07 (MT, Herbier Marie-Victorin of the University of Montreal).

Additional specimen examined: *N. parasitans*, Austria, on twigs of *Tilia cordata*, 2. IV. 2000, Herbar GZU (Institut für Botanik of Karl-Franzens-Universität), Inv. Nr. 9-2000.

DISCUSSION

Nitschkia parasitans var. *mijuskovicii* grows well on stromata of *Nectria cinnabarina* in the ecological conditions of the greater Montreal region. Stromata may at the same time bear fully developed ascomata of both *Nitschkia* and *Nectria* (Figures 3 and 4), as has been previously reported by Nannfeldt (1975b). Often, when *Nitschkia* is vigorous, necrotic stromatal patches or completely destroyed stromata of *Nectria* have been observed (Figure 2). This behaviour of *N. parasitans* var. *mijuskovicii* could be considered hyperparasitic and potentially useful in biological control. *Nectria cinnabarina* is a very common tree pathogen causing cankers and dieback on a wide range of hosts, mostly hardwoods, elsewhere in North America (Sinclair et al. 1993). The

SEE ERRATA

Erratum

Vol. 82, April-June 2002

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The damage caused by this fungus is often observed on ornamental trees, as was observed in the Montreal Botanical Garden plantations (data non published).

Although Nannfeldt (1975b) states that *N. fuckelii* and *N. moravica* are synonyms of *N. parasitans*, my opinion is that those two species represent the same new variety: *N. parasitans* var. *mijuskovicii*, proposed herein. The comparative measures (Table 1) segregate *Nitschkia parasitans* var. *mijuskovicii* from the species type by way of their minute ascomata (mean : 200 µm diam) and spores that are never longer than 11 µm (l/w ratio: 1 : 3 for *N. parasitans* var. *mijuskovicii* and 1 : 5 for *Nitschkia parasitans*, respectively).

Table 1. Comparison of published measurements of the reproductive structures of *Nitschkia parasitans* var. *mijuskovicii* (*Npm*) with examined specimens of *Nitschkia parasitans* from *Nectria cinnabarina* (µm)

	Nannfeldt (1975b)	**Fitzpatrick (1923)**	**Fitzpatrick (1923)**	**Our results (2001)**	**Our results (2001)**
Species	***N. parasitans***	***N. fuckelii***	***N. moravica***	***Npm***	***Npm***
	= Sphaeria parasitans *= N. fuckelii,* *= N. ancemps,* *= N moravica*			*=N. parasitans**	(Holotypus : MT-NC07)
Ascomata	200-300	200-270	200	150-250	150-270
Asci	-	25-35 x 10	50-70 x 12	30-50 x 5-7	35-65 x 5-10
Ascospores	9-16 x 2-3	9-11 x 2	10-11 x 2-3	5-10 x 2-2.8	5-11 x 2-2.8

*Examined specimen of *N. parasitans* on *Tilia cordata* provided by Scheurer (2001)

We need to make additional investigations in order to establish phylogenetic connections between the proposed fungal variety and the species type, including the other five reported *Nitschkia* species on *Fagus* hosts.

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The authors thanks to Dr. C. Scheuer, mycologist from the Institut für Botanik of Karl-Franzens-Universität, Austria, for the loan of specimens of *Nitschkia parasitans*, and to Dr. Brenda Callan, mycologist from the Canadian Forest Service - Pacific Forestry Centre, for manuscript review as well as useful comments and suggestions.

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SPEIROPSIS ROGERGOOSENSIS SP. NOV. FROM INDIA

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ABSTRACT

A new dematiaceous hyphomycete, *Speiropsis rogergoosensis*, producing unicellular conidia connected by narrow isthmi in profusely branched chains on polyblastic discrete conidiogenous cells, recovered from decaying leaves of *Artocarpus hirsutus* Lam. (Moraceae) is described from the forests of Western Ghats in southern India.

Key words: Biodiversity, Taxonomy, Hyphomycetes, Western Ghats

INTRODUCTION

During studies on the taxonomy and diversity of microfungi of the forests of Western Ghats in southern India, an interesting dematiaceous hyphomycete producing hyaline, smooth, unicellular conidia connected by narrow isthmi in profusely branched chains on polyblastic discrete conidiogenous cells and long, thick-walled, dark brown, septate, conidiophores arising singly or in fascicles was isolated from fallen and decaying leaves of *Artocarpus hirsutus* Lam. (Moraceae) from the forests of Western Ghats in Karnataka State, India. The fungus is described here as a new species of the genus *Speiropsis* Tubaki.

Fallen, dead leaves of *Artocarpus hirsutus,* when incubated in sterile moist chamber in the laboratory, produced fascicles of conidiophores with white masses of conidia appearing on the leaf surface after two weeks.

TAXONOMIC PART

Speiropsis rogergoosensis Kesh. Prasad et Bhat **sp. nov.** (Fig.1 & 2)
[Etym.: In honour of Prof. Roger D. Goos, a distinguished mycologist, who contributed immensely to the study of biodiversity of hyphomycetous fungi]

Coloniae effusae, olivaceae vel atrobrunneae. *Mycelium* partim immersum, ex hyphis septatis, ramosis, hyalinis vel pallide brunneis, 2.5-3.0 µm lat. compositum. *Conidiophora* mononematosa, erecta, recta vel flexuosa, singularis vel fasciculata ex 2-6, enata fuscus stroma, 2-3-septata, crassitunicata, atro-brunnea, ad apicem pallidora, laevia, 40-65 µm longa, 3-4.5 µm lat. et proferens ad ramosa in supra, hyalina, 15-30 µm longa, 2-4.5 µm lat. *Cellulae conidiogenae* polyblasticae, discretae, terminalis, hyalina, denticulatae ad apicem, 6-9 µm longae, supra 2.5-4 µm lat., infra 2-3 µm lat.

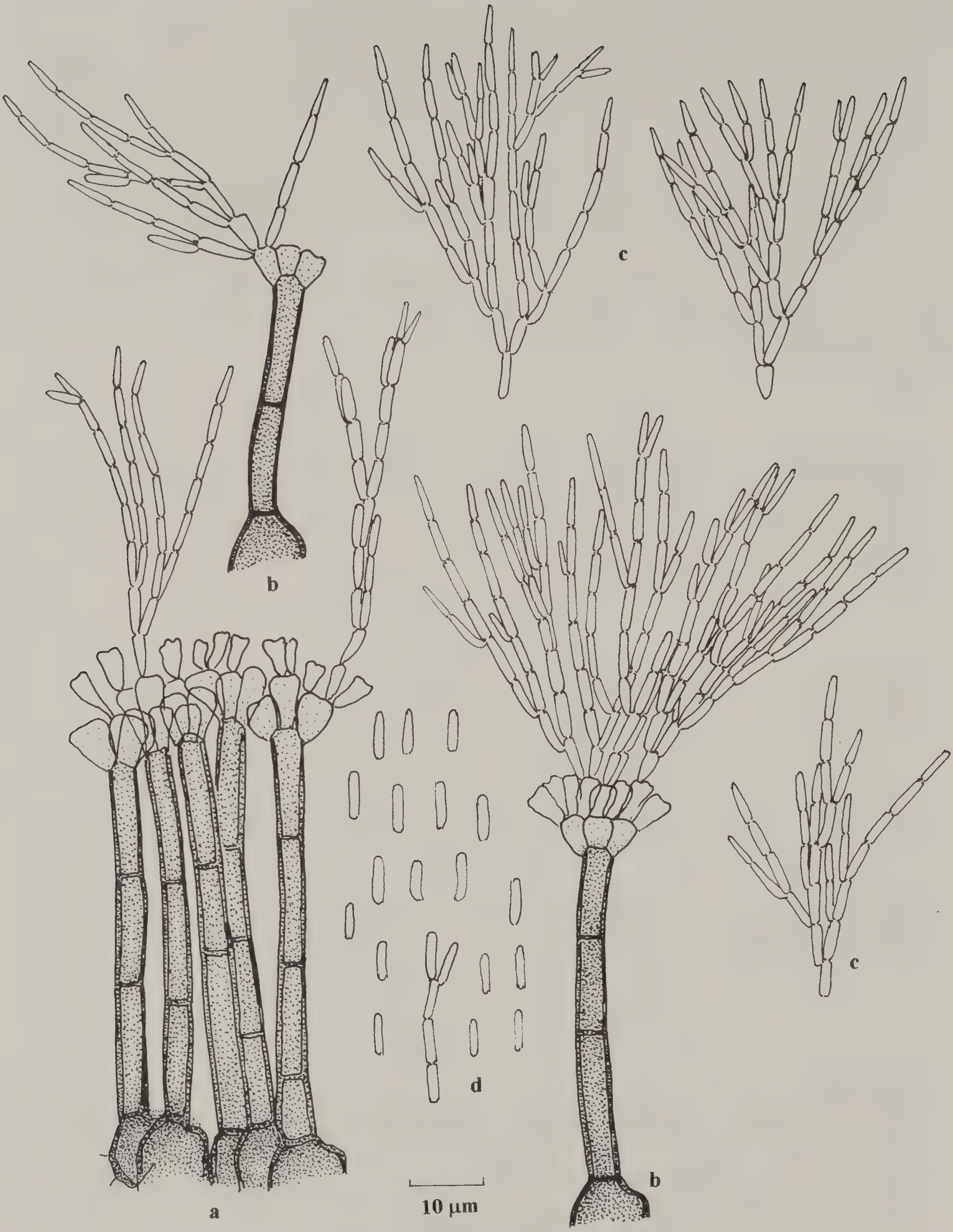

Fig. 1. *Speiropsis rogergoosensis:* **a**. Fasciculate conidiomata, **b.** Single conidiophore with fertile lateral branches, **c.** Conidia in branched chains, **d.** Conidia.

Conidiae catenata, hyalina, cylindricalis, interdum curvata, utrinque truncata, laevia, aseptata, 4-6 x 1-2 μm, plerumque in multiramosa, infra uniseriata et supra bi- ad heptaseriata, 40-65 μm longa; cellulae apicale et basalem, conicale vel obclavatae, 3-7 x 1-1.5μm.

HOLOTYPUS, In foliis putrescentibus *Artocarpus hirsutus,* Kumara Parvatha, Subrahmanya, Karnataka, India, 11 Sept. 2001, Keshava Prasad, Herb. No. IMI 387092.

Terrestrial litter hyphomycete. *Colonies* effuse, olivaceous brown, velvety. *Mycelium* partly immersed, composed of septate, and branched, colourless to pale brown hyphae 2.5-3 μm wide. *Conidiophores* mononematous, erect, straight or flexuous, arising singly or in fascicles of 2-6 from a dark brown stroma, 2-3 septate, thick-walled, smooth, dark brown, paler towards the tip, 40-65 μm long, 3-4.5 μm wide, with an apical cluster of 3-5 conidiogenous cells. *Conidiogenous cells* polyblastic, discrete, terminal, hyaline, wider above, smooth, thin-walled, with denticulate projections at the truncate apex, 6-9 μm long, 2.5-4 μm wide above, 2-3 μm wide below, sometimes in two tiers. *Conidia* catenate, hyaline, cylindrical, sometimes curved, truncate at both ends, smooth, aseptate, 4-6 x 1-2 μm, connected by narrow isthmi, in mass whitish, developing in branched chains of 40-65 μm long, uniseriate below, bi- to hepta-seriate above, with branches arising from basal up to penultimate terminal cell of the axis; apical and basal conidia conical to obclavate, 3-7 x 1-1.5 μm.

So far 8 species have been described in the genus *Speiropsis* Tubaki (1958), typified by *S. pedatospora* Tubaki. The genus is characterised by simple conidia connected by narrow isthmi developing in unbranched or branched chains on mononematous conidiophores with discrete, polyblastic conidiogenous cells. In *Speiropsis aquatica* Aramb., Cabello & Megascini (Arambari & al., 1987), *Speiropsis belauensis* Matsush. (Matsushima, 1985), *S. ixorae* Subram. & Sudha (Subramarian & Sudha,1986), *S. scopiformis* Kuthub. & Nawawi (Kuthubutheen & Nawawi, 1987) and *S. simplex* Matsush. (Matsushima, 1971) conidia are produced in unbranched chains whereas in *S. hyalospora* Subram. & Lodha (Subramarian & Lodha,1964), *S. irregularis* R.H. Petersen (1963) and *S. pedatospora* conidia are in branched chains. The new species, *Speiropsis rogergoosensis,* has catenate conidia developed in divergent branched chains.

In *S. irregularis*, the conidia are subspherical, pale to mid-brown, 4.4-7.0 x 5.5-12.5 μm and the branching is irregular and divergent. In *S. pedatospora*, the conidia are cylindrical to cuneiform, pale to mid-brown, 10-14 x 4-7 μm and branching is more or less regular and divergent. In *S. hyalospora,* conidia are hyaline, 8-10 x 3.5-5 μm, developing in triseriate chains with first and second branches originating from distal end of basal and epibasal cells of the main axis. In *S. rogergoosensis*, the cylindrical hyaline conidia are straight or curved and developed in profusely and dichotomously branched chains. The branching is visible even in the terminal cell of the chain. The conidia are 4-6 x 1-2 μm, the smallest of all so far known species in the genus.

The key to the species of *Speiropsis* proposed by Kuthubutheen & Nawawi (1987) is updated below incorporating the later described taxa.

1. Conidia in branched chains	2
1. Conidia in unbranched chains	5

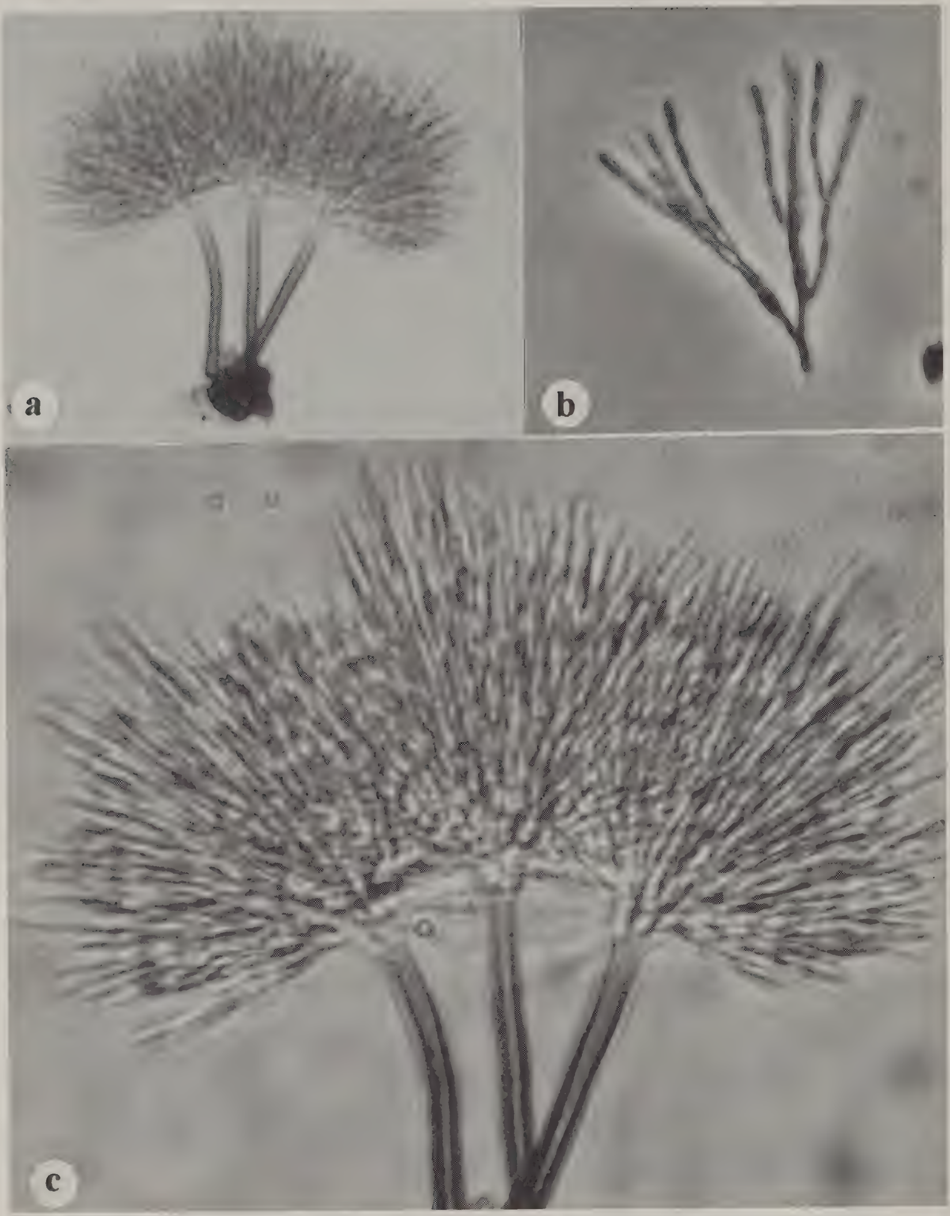

Fig. 2. *Speiropsis rogergoosensis:* **a.** Fasciculate conidiomata, **b.** Conidia in branched chains, **c.** Fertile portions of conidiophores.

2. Branching regular 3
2. Branching irregular, 3-7divergent branches; conidia subspherical, 4.4-7.0 x 5.5- 2.5 µm *S. irregularis*
3. Conidia pale to mid brown, 10-14 x 4-7 µm *S. pedatospora*
3. Conidia hyaline 4
4. Conidial chains tri-seriate, conidia 8-10 x 3.5-5 µm *S. hyalospora*
4. Conidial chains with many divergent branches; conidia narrow cylindrical, 4-6 x 1-2 µm *S. rogergoosensis*
5. Conidiophores branched, mostly aggregated in fascicles or appearing synnematous to sporodochial 6
5. Conidiophores unbranched and solitary 7
6. Conidia 7-9 cells, conidial chains 80-110 x 4-5 µm *S. simplex*
6. Conidia 5-7 cells, conidial chains 40-60 x 4-5 µm *S. belauensis*
7. Conidiophores 75-110 x 4-5 µm; conidial chains 5-7 cells, 40-65 x 2-3µm *S. scopiformis*
7. Conidiophores 45-52.5 x 5-5.5µm; conidial chains 5-6 cells, 33.5-46.5 x 2.8-3.3µm *S. ixorae*
7. Conidiophores 75-120 x 3-5µm; conidial chains 6-7 cells, 40-50 x 2.6-3µm *S. aquatica*

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NEW CONIDIAL FUNGI FROM ANDAMAN ISLANDS, INDIA

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ABSTRACT

Four new species of litter-inhabiting Hyphomycetes are described from the forests of Middle Andaman Island, India. These are: (1) *Argopericonia indiraei* sp. nov, characterized by catenate, globose, hyaline blastic conidia developing on flexuous conidiophores with discrete conidiogenous cells; (2) *Virgatospora natarajensis* sp. nov. producing fusiform, non-septate, olive green to dark brown, phialidic conidia with longitudinal surface ridges on erect synnematous conidiomata, both isolated from decaying leaves of *Calamus thwaitesii;* (3) *Phialocephala vittalensis* sp. nov. with catenate, 1-septate, pale brown, phialidic conidia developing on apically branched conidiophores; and (4) *Stratiphoromyces raghukumarensis* sp. nov. producing fusiform, curved, 1-septate, phialidic conidia on percurrently regenerating conidiophores, isolated from fallen leaves of *Caryota urens*.

Key words: Biodiversity, Taxonomy, Hyphomycetes

INTRODUCTION

The Andamans, a string of about 350 islands in the Bay of Bengal, lying between 6° and 14°N, and 92° and 94° E, harbour dense evergreen tropical forests in their interiors while extensive mangrove swamps fringe their coastlines. The islands have a warm and humid climate with temperature ranging from 24°-36°C, relative humidity between 80-90% and rainfall of up to 450 cm per year. Geographic isolation and relative inaccessibility from the mainland have thus far contributed to preservation of the forests on the islands.

No authoritative reports have yet been published on the litter fungi of Andaman and Nicobar Islands, India, except that of Bhat & Kendrick (1993). During a floristic study of the fungi of the forests of the Andaman Islands and Western Ghats in southern India, Bhat and Kendrick (1993) described 9 new conidial fungi from the Andaman region. In the present study, an additional 4 novel taxa of hyphomycetes isolated from fallen and decaying leaves of *Calamus thwaitesii* Becc. and *Caryota urens* Linn. are described.

These hitherto unknown fungi are named in honour of four contemporary mycologists who have contributed significantly to the development of taxonomic mycology in India.

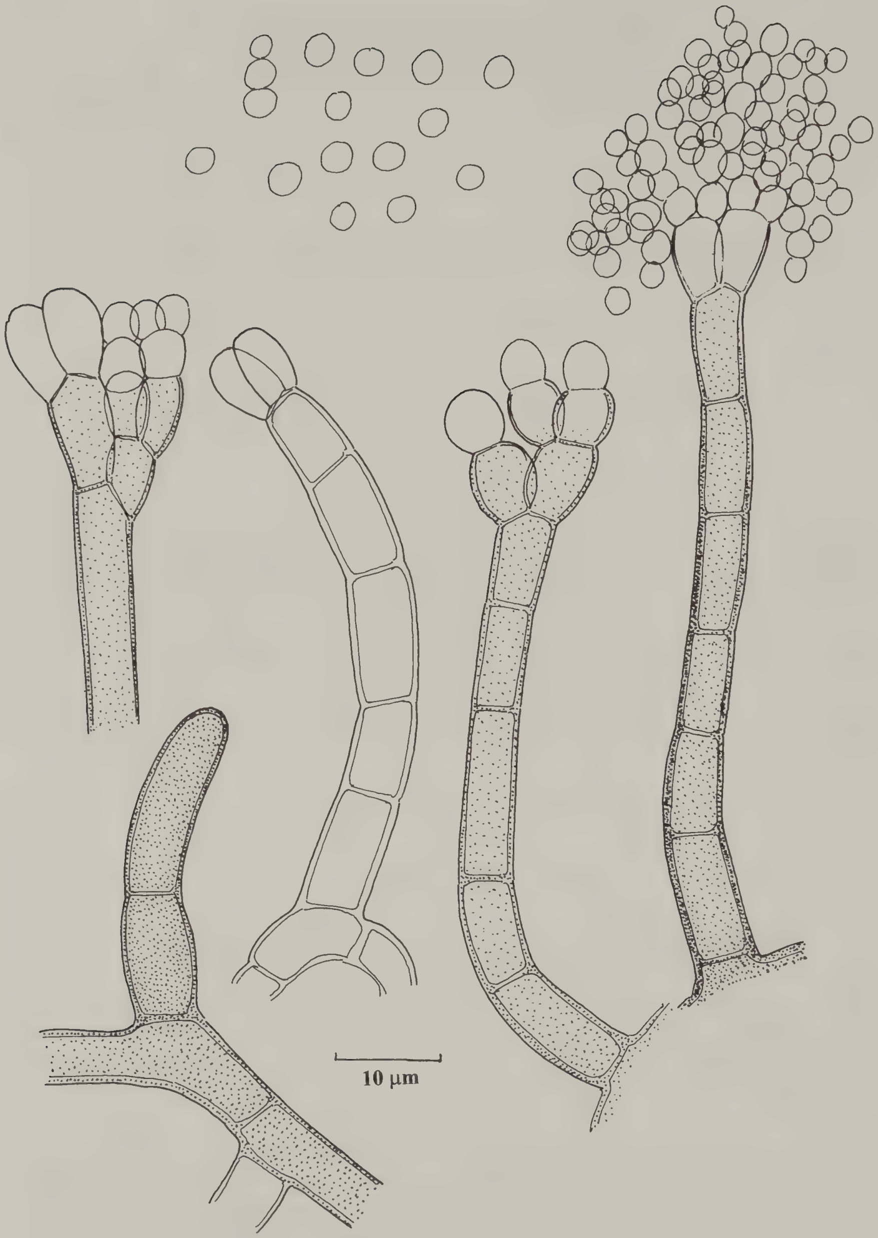

Fig.1. *Argopericonia indiraei:* **a.**Young conidiophore, **b.** Conidiophore with conidiogenous cells, **c.** Conidiophore with conidiogenous cells and catenate conidia.

MATERIALS AND METHODS

Fallen and decaying leaves of *Calamus thwaitesii* Becc. and *Caryota urens* Linn. were air-lifted to the mainland and incubated in sterile moist chambers for 7-14 days. The sporulating fungi were mounted in lactophenol and examined under the microscope.

Part of the leaf litter was cut into small bits and ground to fine particles in an electric blender. The particles were filtered through two superimposed metal sieves with mesh size of 250μm and 100 μm. The fine particles of between 100 and 250 μm size, trapped in the lower sieve, were repeatedly washed in sterile distilled water and plated on malt extract agar (MEA) medium containing a mixture of antibiotics (Bacitracin 0.02 g, Neomycin 0.02 g, Penicillin G 0.02g, Polymixin 0.02g, Streptomycin 0.02g and Terramycin 0.04g dissolved in 10 ml of distilled water and added to 1 L of MEA medium). Fungal hyphae arising from the particles were aseptically and individually transferred into fresh MEA slants. The fungi in culture sporulated after several weeks of incubation. These were examined under the microscope. Camera lucida drawings were made using a drawing tube attached to an Olympus microscope.

TAXONOMIC DESCRIPTION

Argopericonia indiraei **sp.nov.** (Fig. 1, a-d)
[Named in honour of Dr. Indira Kalyanasundaram, C.A.S.in Botany, University of Madras, Chennai, India]

Ad fungos conidiales, Hyphomycetes, pertinens. *Coloniae* in MEA regulares, tardus cresco, atro olivaceo viridis, ad marginiae rhizoidalis, usque ad 1 cm diam post 7 dies. *Mycelium* humiduin partim immersum, ex hyphis superficialis laevis, septatis, ramosis, tenui-tunicatis, pallide brunnis, 1.5-2 μm latis compositis. *Conidiophora* ex mycelii superficialis orienda, singula, discreta, erecta, recta, laevia, 3-7-septata, ramosa versus apicem, atrobrunnea, crassitunicata, 50-115 x 3-5 μm. *Cellulae conidiogenae* discretae, terminales, ellipsoideae, polyblasticae, cicatrices non incrassatae, laeviae, hyalinae, 4-5 x 2-3 μm. *Conidia* solitaria vel catenata, in catenis ramosis acropetalia; globosa, non-septata (amerosporia), laevia, hyalina, 2.5-4 μm diam, collapsis in mucosa massis.

HOLOTYPUS: Cultura in MEA exiccata, extractis in putridinis foliis *Calamus thwaitesii,* Middle Andaman Islands, leg. Maria D'Souza, 31 Jan. 2000, IMI 386675

Conidial fungi, hyphomycetes. *Colonies* on MEA regular in outline, adpressed, flat, with rhizoidal margin, dark olive green, slow growing, attaining a diam of 1 cm after 7 days. *Mycelium* partly immersed, partly superficial, composed of smooth-walled, septate, branched, pale brown, hyphae 1.5-2 μm wide, often aggregated into superficial mycelial knots 10-20 μm diam. *Conidiophores* single, discrete, erect, straight or flexuous, smooth, thick-walled, 3-7-septate, 50-115 x 3-5 μm, dark brown in the lower half, branched and pale brown to colourless toward the tip, with rhizoid-like branches at the base, arising from superficial mycelium. *Conidiogenous cells* discrete, terminal, ellipsoidal, colourless, polyblastic, with unthickened scars, 4-5 x 2-3 μm. *Conidia* solitary to catenate, globose, nonseptate (amerosporous), smooth, hyaline, 2.5-4 μm diam, developing in branched, acropetal chains, often collapsing into slimy, globular mass.

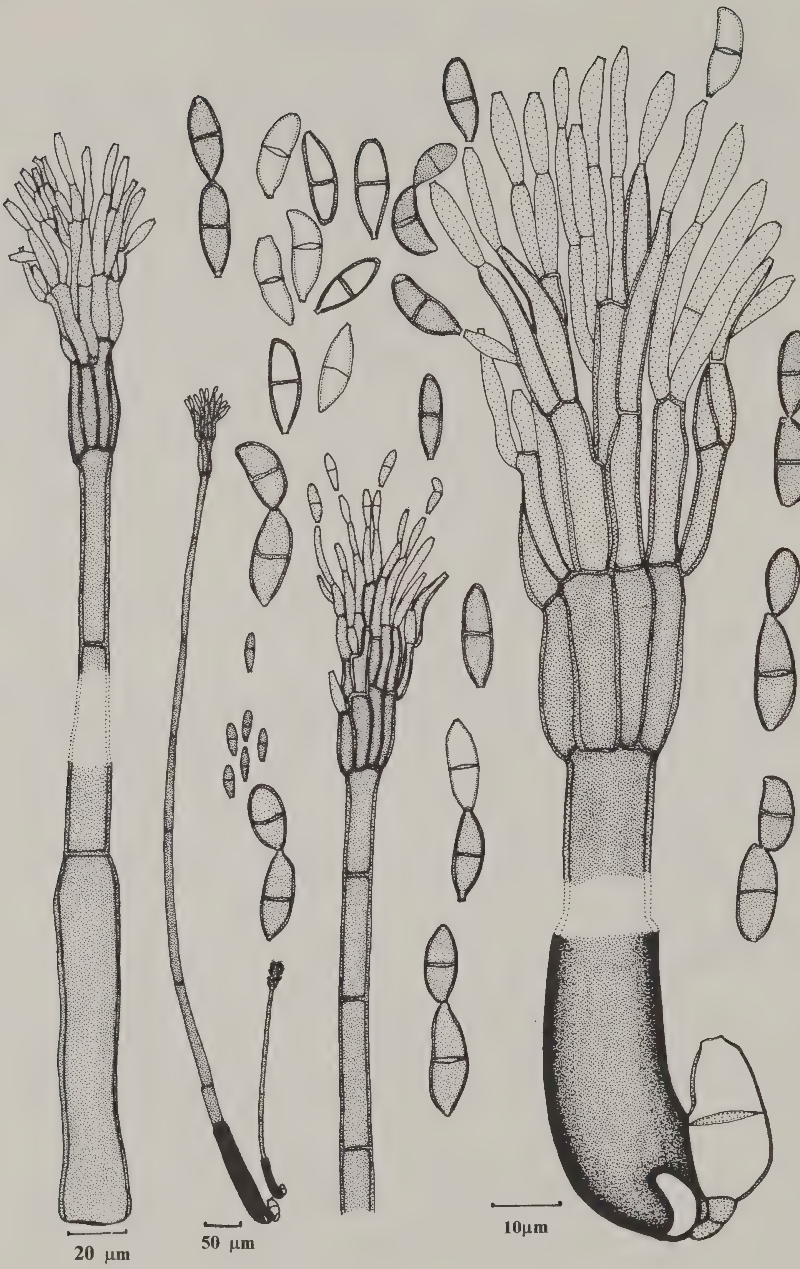
20 µm
50 µm
10µm

Fig.2. *Phialocephala vittalensis:* **a.** Mature conidiophores, **b.** Enlarged conidiophores, **c.** Conidia, **d.** Catenate conidia.

The previously monotypic genus *Argopericonia* B.Sutton & Pascoe (1987), typified by *A. elegans* B.Sutton & Pascoe, is characterized by production of solitary or shortly catenate, hyaline, ellipsoidal, smooth, polyblastic conidia on integrated hyaline, apical, cuneiform conidiogenous cells, and dark brown, single conidiophores. Conidiogenesis in *Argopericonia* is similar to that of *Periconia* Tode: Fr. Though similar to *Argopericonia elegans*, *A. indiraei* differs from the type by its (i) globose and smaller conidia (conidia in *A. elegans* are ellipsoidal, 11-12.5 x 7-8.5 µm) which develop in branched, acropetal chains and often collapse into slimy, globular masses, (ii) terminally branched conidiophores and (iii) conidiophores arising from rhizoid-like branches at the base.

Phialocephala vittalensis **sp. nov.** (Fig.2, a-d)
[Named in honour of Dr. B.P.R. Vittal, C.A.S. in Botany, University of Madras, Chennai, India)]

Ad fungos conidiales, Hyphomycetes, pertinens. *Coloniae* effusae, amphigenae. *Mycelium* partim immersum, ex hyphis superficialis septatis, laevis, ramosis, tenui-tunicatis, hyalinis, 2-3 µm latis, composito. *Conidiophora* singula, erecta, recta vel raro flexuosa, laevia, atrobrunnea, crassitunicata, 4-6-septata, 360-1200 x 10-20 µm, usque ad 25 µm lata ad basim,10-15 µm lata ad apicem, palliodora versus supra dimidiatum, septatum, ex stipite penicilliformi composita et ordenare in 3-5 serie metularum. *Cellulae conidiogenae* in conidiophoris incorporatae, terminales, monophialidicae, enteroblasticae, tenui-tunicatae, subhyalinae, hyalo non incrassato, 10-30 x 2.5-5 µm, experse collaretto, *Conidia* solitaria to catenata, in catenis subterminaliter formata, fusiforma vel ellpsoidea, recta vel curvata, basim attenuate truncata, apicem papillata vel rotundata, laevia, 1-septata, pelleda brunnea, 9-18 x 3-5 µm, omnia glutinata.

HOLOTYPUS: In foliis emortuis *Caryota urens*, Middle Andaman Island, leg. Rajiv Kumar, 15 Dec. 2000, IMI 386678.

Conidial fungi, hyphomycetes. *Colonies* effuse, amphigenous. *Mycelium* partly immersed, composed of septate, branched, smooth hyphae 2-3 µm wide. *Conidiophores* solitary, erect, straight to rarely flexuous, smooth-walled, dark brown, thick-walled, 4-6-septate, 360-1200 x 10-20 µm, up to 25 µm wide at the base, slightly paler and penicillately branched in the apical region, with 3-5 series of metulae bearing an apical cluster of phialides. *Conidiogenous cells* terminal, discrete, monophialidic, enteroblastic, thin-walled, subhyaline, 10-30 x 2.5-5 µm, without collarette. *Conidia* solitary to shortly-catenate, in subterminally attached chains, fusiform to ellipsoidal, slightly curved, base narrowly truncate, papillate to rounded at the tip, smooth, 1-septate (didymosporous), mid brown, 9-18 x 3-5 µm, produced in slimy masses.

The genus *Phialocephala* W.B.Kendr. (Kendrick, 1961), with *P. dimorphospora* W.B.Kendr. as type species, presently accommodates 21 species reported from all over the world (Crane, 1971; Jong & Davis, 1972; Kendrick, 1963a,b; Kendrick, 1964; Kowalski & Kehr, 1995; Kirschner & Oberwinkler, 1998; Maggi & Persiani, 1984; Matsushima, 1989; Onofri & Zucconi, 1984; Onofri et al., 1994; Shearer et al., 1976; Siegfried et al., 1992; Sutton, 1975; Sivasithamparam, 1975; Wingfield, 1985; Wang & Wilcox, 1985; Wingfield et al., 1987; Vujanovic et al., 2000). According to Onofri & Zucconi (1984) and Vujanovic et al. (2000), who provided taxonomic keys, the species of *Phialocephala* can be segregated into two groups, those with well-defined and conspicuous collarettes on the phialides and those without well-defined collarettes. *P. vittalensis* falls into the latter

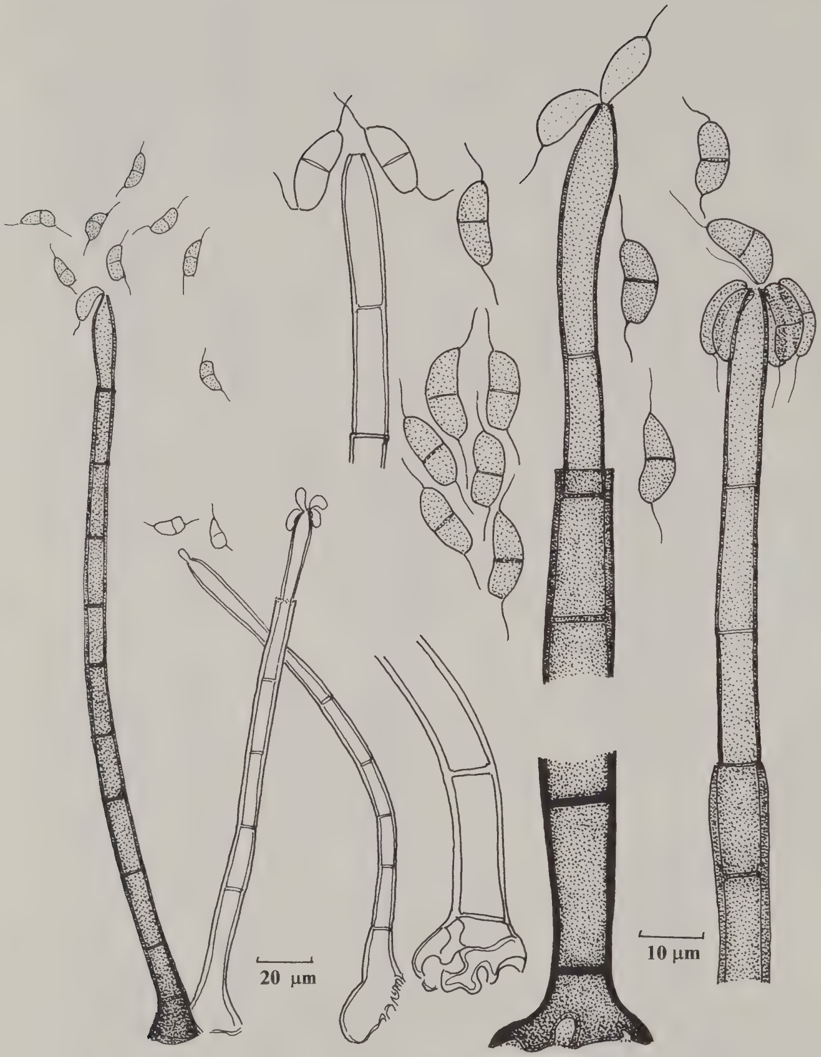

Fig. 3. *Stratiphoromyces raghukumarensis:* **a.** Mature conidiophores, **b.** Portion of conidiophores and conidiogenous cells, **c.** Conidia.

category. Further, among the species without conspicuous collarettes, *P. vittalensis* can be compared only with *P. ivoriensis* Zucconi & Onofri, in which the conidia are catenate, terminally attached to each other in the chain, subcylindrical, non-septate, pale brown and 4.5-5.4 x 1.8-2.2 μm. *P. vittalensis* differs in its fusiform, apically papillate, curved, 1-septate (didymosporous), mid brown conidia, 9-18 x 3-5 μm, arranged in subterminally attached chains.

Stratiphoromyces raghukumarensis **sp. nov.** (Fig.3, a-c)
[Named in honour of Dr. S. Raghukumar, National Institute of Oceanography, Goa, India]

Ad fungos conidiales, Hyphomycetes, pertinens. *Coloniae* in substrato naturali effusae, atrobrunneae. *Mycelium* partim immersum, ex hyphis superficialis septatis, laevis, ramosis, tenui-tunicatis, hyalinis vel pallide brunneis, 2-2.5 μm latis, composito. *Conidiophora* singula, erecta, recta vel flexuosa, multiseptata, non-ramosa, crassitunicata, atrobrunnea ad basim, luteobrunnea vel fere hyalinae ad apicem, regeneratione percurrenti, 120-250 x 9-15 μm. *Cellulae conidiogenae* monophialidicae, incorporatae terminales, lageniformes, supra medium ad crassa, apicem versus deminutae crassae, successione conidiorum planum eundem producentes proliferatione enteroblastica, 30-40 x 5-8 μm, experse collaretto. *Conidia* solitaria, ellipsoidea, curvata, laevia, 1-septata, nonconstricta ad septa, ex cellula distalis triangularia, cellula proximitatis rhomboidea cum hilo inflato praedita, laevia, 10-15 x 3-5 μm; una setula ad apicem et una ad basim, flexuosa, usque ad 8 μm longa.

HOLOTYPUS: In foliis emortuis *Caryota urens*, Middle Andaman Island, leg. Rajiv Kumar, 15 Dec. 2000, IMI 386679.

Conidial fungi, hyphomycetes. *Colonies* on natural substrate effuse, confined to the edges of leaf substrate, dark brown. *Mycelium* partly immersed, composed of septate, branched, hyaline to pale brown, smooth hyphae 2-2.5 μm wide. *Conidiophores* single, erect, straight to flexuous, multiseptate, unbranched, thick-walled, dark brown in the lower half, light brown at the apex, percurrently regenerating from broken ends, 120-250 x 9-15 μm. *Conidiogenous cells* monophialidic, integrated, terminal, spathulate to lageniform, broadest above the middle, narrower at the apex, without a collarette, 30-40 x 5-8 μm, with simultaneously developing enteroblastic conidia. *Conidia* solitary, ellipsoidal, slightly curved, 1-septate, not constricted at the septum, with distal cell triangular and proximal cell rhomboidal, without a protuberant hilum, rounded at the tip, smooth-walled, 10-15 x 3-5 μm, with a single, flexuous setula up to 8 μm long at each end.

With its spathulate to lageniform, phialidic conidiogenous cells and setulate, ellipsoidal, curved, moderately brown didymoconidia, this fungus shows some similarity to *Kylindria excentrica* Bhat & B.Sutton (1985) and *Stratiphoromyces brunneisporus* Goh & Hyde (1998). The genus *Kylindria* DiCosmo, Berch & W.B.Kendr. (DoCosmo & al., 1983), with *K. triseptata* (Matsush.) DiCosmo et al. as type, is characterized by production of one- to several-septate, colourless conidia from monophialidic conidiogenous cells with narrow apertures, borne on setiform, dark conidiophores, whereas in the monotypic genus *Stratiphoromyces* Goh & K.D.Hyde (1998), typified by *S. brunneisporus* Goh & K.D.Hyde, the conidiophores are stout, erect, mononematous and percurrently regenerating, and the conidiogenous cells repeatedly proliferate to produce a crop of solitary, rhexolytically

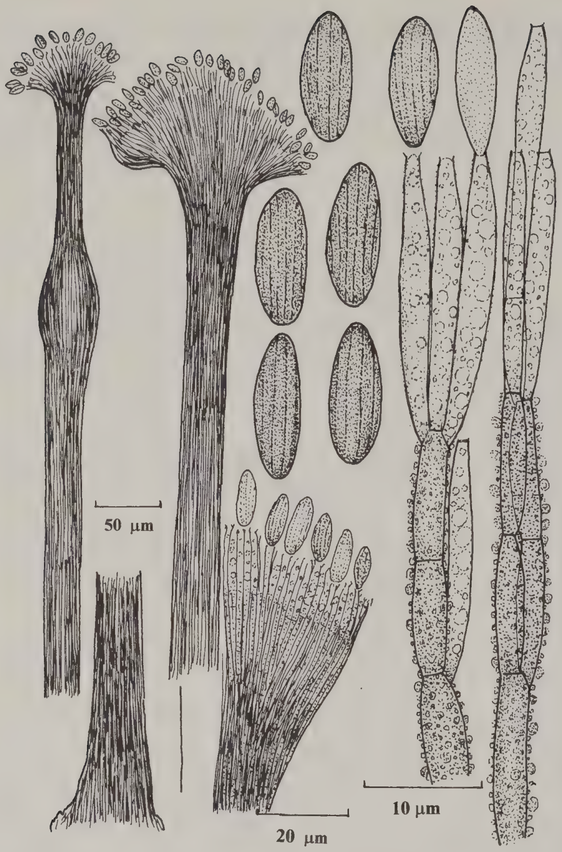

Fig. 4. *Virgatospora natarajensis:* **a.** Synnema, **b.** Portion of synnema, **c.** Conidiogenous cells (phialides), **d.** Conidia.

seceding, brown, 1-septate, curved, setulate conidia with a triangular distal cell and a rhomboidal proximal cell with a conspicuously protruding hilum.

In our opinion, conidiogenesis in *Stratiphoromyces* is phialidic and similar to that in *Kylindria.* The illustration in Fig. 20 of *Stratiphoromyces brunneisporus* (p. 1151, Goh & Hyde, 1998), clearly shows a conidiogenous cell with narrow apical aperture and phialidic conidiogenesis. There is a need for reexamination of the type of *S. brunneisporus* and redescription of the genus *Stratiphoromyces*.

However, the moderately brown, setulate, 1-septate, curved conidia with distal triangular cell and proximal rhomboidal cell of *Stratiphoromyces* significantly differ from those of *Kylindria*. Our fungus is similar to *Stratiphoromyces* in its conidial morphology and is therefore described as a new species, *S. raghukumarensis,* which differs from the type species in having occasionally proliferating conidiophores and the absence of a protruding hilum from the rhomboidal proximal cell of the conidium.

Virgatospora natarajanensis **sp.nov.** (Fig.4, a-d)

[Named in honour of Dr. K. Natarajan, C.A.S. in Botany, University of Madras, Chennai, India]

Ad fungos conidiales, hyphomycetes, pertinens. *Coloniae* effusae, olivaceae melano, ex synnematis numeroso irregulariter interspersus, rectus, de leuco vel griseus, viridulus mucosus capitatus, compositum. *Mycelium* plerumque in substrato immersum, ex hyphis crassitunicatis, septatis, ramosis, hyalinis, 2-4 µm lat. composito. *Conidiomata* synnematosa, *conidiophoris* crassitunicatis, septatis, ramosis, laevis inter basilaris partis, distinctae echinulatus inter apicalis fertilis regionis, subhyalinis; synnemata usque ad 680 µm longa, in basim usque ad 90 µm, in medio 25-35 µm lat., apice in capitulum fertile expanso usque ad 170 µm lat. *Cellulae conidiogenae* monophialidicae, discretae, plerumque terminales, interdum subterminales, elongatae, subcylindricae, recte vel subcurvatae, 18-25 µm longae, in basim usque ad 2-2.5 µm lat., in medio 2-3.5 µm lat, usque ad 1.5 µm lat. in apicem, cum collarulo distincto apicali 2.5 µm lat. *Conidia* solitaria, ellipsoidea vel fusiformia, aseptata, olivea viridis vel brunneis, cum costatis distinctis longitudinalis in superficie, 10-13.5 µm longa, 3.5-4.5 µm lat. in medio, rotundata ambi terminalis, crassitunicata, aggregatae in capitatis mucosis ad apicem synnemata.

HOLOTYPUS: In foliis emortuis *Calamus thwaitesii,* Middle Andaman Island, leg. Rajiv Kumar, 15 Dec.2000, IMI 386680.

Conidial fungi, hyphomycetes. *Colonies* effuse, olivaceous black, composed of a number of irregularly scattered erect, off-white to greyish, synnematal conidiomata with greenish slimy heads. *Mycelium* partly immersed, composed of smooth, septate, and branched, hyaline, thin-walled, hyphae 2-3 µm wide. *Conidiomata* synnematous, *conidiophores* thick-walled, septate, branched, smooth below, distinctly echinulate toward the apex, subhyaline, synnemata up to 680 µm long, up to 90 µm thick at the base, 25-35 µm thick in the middle, up to 170 µm thick at the flared apex. *Conidiogenous cells* monophialidic, discrete, mostly terminal, sometimes subterminal, elongate, subcylindrical, straight or slightly curved, smooth, 18-25 µm long, 2-2.5 µm wide at the base, 2-3.5 µm wide in the middle, up to 1.5 µm wide at the tip, with a distinct collarette 2.5 µm wide at the apex. *Conidia* solitary, ellipsoidal to fusiform, non-septate (amerosporous), pale olive green to brown, with distinct longitudinal ridges on the surface, 10-13.5 µm long, 3.5-4.5 µm wide in the middle, rounded at both ends, thick-walled, aggregated in large slimy heads at the tips of synnemata.

The monotypic genus *Virgatospora* Finley (1967), with *V. echinofibrosa* Finley as type species, was described for synnematous fungi producing slimy, septate, phialidic conidia with distinct longitudinal ridges, on the surface on echinulate conidiophores (Bills et al., 1994). *V. natarajanensis* differs from the type by its fusiform, non-septate, smaller conidia. The conidia in *V. echinofibrosa* are ellipsoidal to limoniform, papillate at both ends, curved, 3-septate (phragmosporous), grey to dark brown, 38-45 x 12-15 µm, whereas in *V. natarajensis* the conidia are fusiform, non-septate (amerosporous), rounded at both ends and 10-13.5 x 3.5-4.5 µm.

ACKNOWLEDGMENTS

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SCOLECIASIS ATKINSONII, AN EARLIER NAME FOR PHAEOPHLEOSPORA HEBES; AND A NOTE ON G.H. CUNNINGHAM'S EPITHETS HEBE AND PSEUDOPANAX

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ABSTRACT

Phaeophleospora hebes (W.Wu, B.Sutton & Gange) Crous, F.A.Ferreira & B.Sutton is conspecific with the earlier *Scoleciasis atkinsonii* Syd. Sydow's epithet is recombined as *Phaeophleospora atkinsonii* (Syd.) Pennycook & McKenzie. The epithets *hebe* and *pseudopanax* published by G.H. Cunningham are interpreted as vernacular names of host plants, used as nouns in apposition; they should not be "corrected" to their respective genitives, *hebes* and *pseudopanacis*.

KEYWORDS: coelomycetes, orthography, pathogens, systematics

In a study of lesions on leaves of New Zealand *Hebe* spp., Laundon (1978) demonstrated that two coelomycetous fungi, *Scoleciasis atkinsonii* Syd. and *Septoria exotica* Speg., had been confused repeatedly, for example by Grove (1935) and Dingley (1969). Herbarium and fresh collections were studied, and found to yield one or other of two distinct fungi, which were conspecific with the types of *Scoleciasis atkinsonii* and *Septoria exotica*, respectively (Laundon 1978). When Wu et al. (1996) created the new species, *Kirramyces hebes* W.Wu, B.Sutton & Gange, they claimed to have searched the literature for coelomycetes with coloured septate conidia, described from *Hebe*. Unaccountably, they overlooked both *Scoleciasis atkinsonii* and the paper by Laundon (1978), in spite of their inclusion of Laundon collections (e.g., LEV 11962 = *Scoleciasis atkinsonii*, fide Laundon 1978) in the protologue of *Kirramyces hebes*. Subsequently, *Kirramyces hebes* has been transferred to *Phaeophleospora* Rangel (Crous et al. 1997).

Unfortunately, the type specimen of *Kirramyces hebes* (IMI 369274) could not be located in the IMI Herbarium (A. Ansell, pers. comm.). However, two New Zealand specimens cited by Wu et al. (1996) — IMI 131207; IMI 216593 (= LEV 11962) — have been examined and compared with the type of *Scoleciasis atkinsonii* (PDD 968). All three specimens are of the same fungus. We conclude that *Kirramyces hebes* is conspecific with the earlier *Scoleciasis atkinsonii*, and propose the transfer of Sydow's epithet to *Phaeophleospora*:

***Phaeophleospora atkinsonii* (Syd.) Pennycook & McKenzie, comb. nov.**
≡ *Scoleciasis atkinsonii* Syd., *Ann. Mycol.* 22: 312, 1924.
= *Septoria exotica* sensu Grove, *Brit. Leaf-fung. 1*: 415, 1935, non Speg., 1880.
= *Kirramyces hebes* W.Wu, B.Sutton & Gange, *Mycol. Res. 100*: 1208, 1996.
≡ *Phaeophleospora hebes* (W.Wu, B.Sutton & Gange) Crous, F.A.Ferreira & B.Sutton, *S. African J. Bot. 63*: 113, 1997.

A NOTE ON G.H. CUNNINGHAM'S EPITHETS *HEBE* AND *PSEUDOPANAX*

Although *hebes* is the correct genitive case for the genus *Hebe*, we believe that Petrak and *Index of Fungi* are misguided in attempting to "correct" the spelling of the epithets of *Aecidium hebe* G.Cunn. (Petrak 1937), *Calyptella hebe* (G.Cunn.) W.B.Cooke (Anon. 1962), *Cyphella hebe* G.Cunn. (Anon. 1963), and *Lachnella hebe* (G.Cunn.) G.Cunn. (Anon. 1964). Although these can be construed as grammatical errors by Cunningham, they are better considered as examples of his frequent habit of coining fungal epithets by using the vernacular name of the host as a noun in apposition. (He published at least 30 other spp. nov. with epithets such as *horopito, kamahi, karetu, kauri, kowhai, maire, manuka, nikau, rata, toatoa, toetoe*, and *totara* — all New Zealand vernacular names of their respective hosts.) In New Zealand, "hebe" is the vernacular name applied collectively to all the numerous endemic species of the genus *Hebe*. The Maori name "koromiko" is restricted to *Hebe salicifolia* and a small number of morphologically similar species.

Exactly the same argument applies to attempts to "correct" (to the genitive *pseudopanacis*) the epithets of *Cyphella pseudopanax* G.Cunn. (Anon. 1963), *Flagelloscypha pseudopanax* (G.Cunn.) Agerer (Anon. 1991), and *Lachnella pseudopanax* (G.Cunn.) W.B.Cooke (Anon. 1962). Moreover, such a "correction" of Agerer's combination in *Flagelloscypha* results in an illegitimate name, a later homonym of *Flagelloscypha pseudopanacis* Agerer (= *Incrustocalyptella pseudopanacis* (Agerer) Agerer). In New Zealand, "pseudopanax" is the vernacular name applied collectively to all the numerous endemic species of the genus *Pseudopanax*. Various Maori names are applied to individual *Pseudopanax* species.

Incidentally, the types of *Flagelloscypha pseudopanacis* Agerer, *Sphaerobasidioscypha citrispora* Agerer, and the genus *Sphaerobasidioscypha* Agerer are all from New Zealand (E. Horak, pers. comm.), not from New Guinea as mistakenly stated in their protologues (Agerer 1975, 1983).

ACKNOWLEDGEMENTS

Funds for this research were provided by the Foundation for Research, Science and Technology.

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TWO NEW SPECIES OF USTILAGINOMYCETES AND A SPECIES NEW TO CHINA

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ABSTRACT Two new species, *Anthracoidea pygmaea* and *Urocystis qinghaiensis* are described and a new species for China, *Urocystis ranunculi* is reported.

KEY WORDS *Anthracoidea pygmaea*, *Urocystis qinghaiensis*, *Urocystis ranunculi*, smut fungi.

Seventy-seven species of *Anthracoidea* were recorded in the world (Vánky 2001). On the section *Hemicarex* of *Kobresia*, only one species, *Anthracoidea smithii* Kukkonen, has been reported. On *Kobresia pygmaea*, in the same section, an *Anthracoidea* has been found twice in western China, Qinghai province. Comparison with known species of *Anthracoidea* on *Kobresia* has shown that it cannot be included satisfactorily in any of them. It differs from *Anthracoidea smithii* in the ustilospore ornamentation. Its ustilospores bear a close resemblance to those of *Anthracoidea linderbergiae* (Kukkonen) Kukkonen, a smut fungus of the section *Kobresia* of *Kobresia*. However, no light-refractive spots are present in *A. linderbergiae*. As Kukkonen (1961) and Vánky (1987) have shown, a certain *Anthracoidea* species only infects host plants within the same section or those of closely related sections. This smut is described as a new species:

Anthracoidea pygmaea L. Guo, **sp. nov**. Figs. 1-3

Sori in ovariis, subglobosi, primo membrane obtectas, deinde rupturas. Massa sporarum nigra, pulverulenta. Ustilosporae globosae, subglobosae, ellipsoidales, ovoideae vel irregulares, 15.5-19.5(-22)×15-19 μm, visu laterali 9-13 μm latae, rubrobrunneae; pariete 1-2(-2.5) μm, aequaliter crasso, locis luce refractivis et operculo hyalino, superficie tenuiter verruculosa.

Sori in ovaries, subglobose, at first covered by a membrane, later ruptured. Spore mass black, powdery. Ustilospores globose, subglobose, ellipsoidal, ovoid or irregular,

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15.5-19.5(-22)×15-19 μm in face view, 9-13 μm wide in side view, reddish-brown; wall 1-2(-2.5) μm, evenly thickened, with light-refractive spots and hyaline cap, surface finely verruculose.

On *Kobresia pygmaea* Clarke, Qinghai: Qilian, alt. 3680 m, 13 VIII 1958, Q. M. Ma 466, HMAS 24401 (holotypus); Qilian, alt. 4000 m, 14 VIII 1958, Q. M. Ma 470, HMAS 24399 (paratypus). Known only from the type locality.

Kobresia pygmaea is a small alpine plant, growing at an elevation of 3200-5400 metres.

So far 17 species of *Anthracoidea* have been reported from China, including *A. elynae* (Syd.) Kukkonen, *A. filifoliae* L. Guo, *A. pygmaea*, *A. smithii* and *A. linderbergiae* on *Kobresia* (Guo 2000).

Urocystis ranunculi (Libert) Moesz,
A Kárpát-medence üszöggombái.
(Les Ustilaginales du Bassin des Carpathes). p. 213, 1950. Figs. 4-5

Sori in leaves and petioles, at first covered by the epidermis, later ruptured. Spore mass black, powdery. Spore balls subglobose, elongated or irregular, 14-38×12.5-29 μm, composed of 1-3(-5) ustilospores, incompletely surrounded by sterile cells. Ustilospores subglobose, ovoid, ellipsoidal or irregular, 12.5-22.5×10-15 μm, light brown or dark brown. Sterile cells subglobose or ellipsoidal, 8-15×6.5-10 μm, yellowish-brown; wall 1-1.5 μm, smooth.

On *Ranunculus japonicus* Thunb., Beijing: Songshan, 12 VI 1986, L. Guo 719, HMAS 55285; Hebei: Xiaowutaishan, 22 VIII 1957, L. W. Xu, J. H. Yu & H. Y. Liu 360, HMAS 67919.

Urocystis ranunculi was first described from France by Libert in 1832 as *Sporisorium ranunculi*. It is widely distributed in Europe, while it is a new species for China (Ling 1953, Wang 1963, Tai 1979).

Urocystis qinghaiensis L. Guo, **sp. nov**. Fig. 6

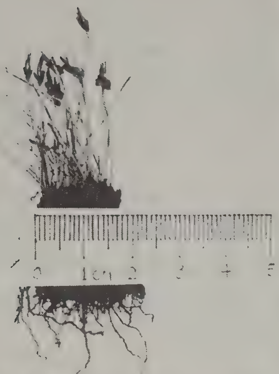
Sori in foliis et vaginis, primo epidermide obtectas, deinde rupturas. Massa sporarum nigra, pulverulenta. Glomeruli sporarum subglobosi, ellipsoidales, ovoidei vel irregulares, e ustilosporis 1-10 constructi, cellulis sterilibus omnino vel incompleto circumdati, 14-50 × 13-35 μm. Ustilosporae subglobosae, ovoideae, ellipsoidales vel irregulares, 9-17×7-12.5 μm, flavidobrunneae vel atrobrunneae; pariete 1-2 μm crasso. Cellulae steriles subglobosae vel ellipsoidales, 7.5-13×4.5-8 μm, flavidobrunneae; pariete inaequaliter incrassato, 0.5-1.5 μm, levi.

Fig. 1. Sori of *Anthracoidea pygmaea* on *Kobresia pygmaea* (HMAS 24401, holotypus).

Figs. 2-3. Ustilospores of *Anthracoidea pygmaea* on *Kobresia pygmaea* in LM and SEM (HMAS 24401, holotypus).

Figs. 4-5. Spore balls, ustilospores and sterile cells of *Urocystis ranunculi* on *Ranunculus japonicus* in LM and SEM (HMAS 67919).

Fig. 6. Spore balls, ustilospores and sterile cells of *Urocystis qinghaiensis* on *Pulsatilla chinensis* in LM (HMAS 24557, holotypus). Bars = 11 μm



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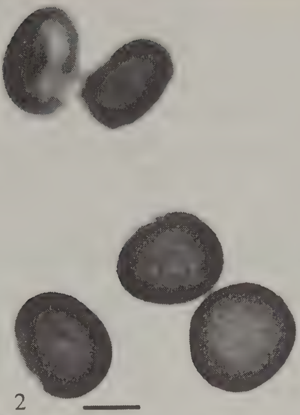

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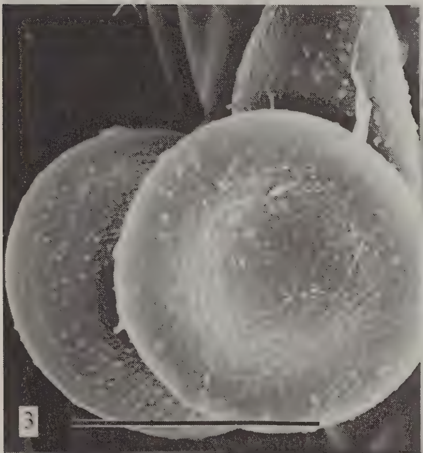

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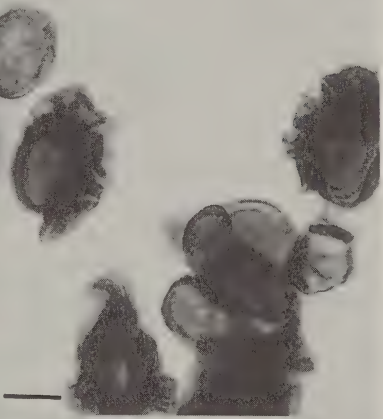

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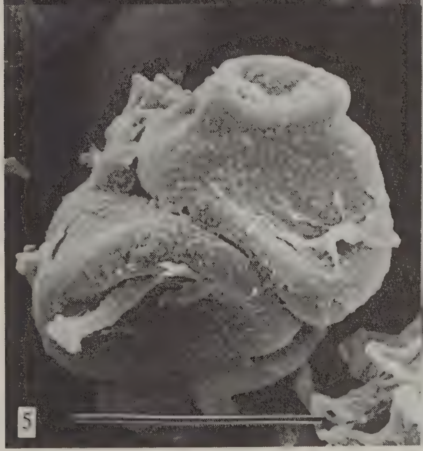

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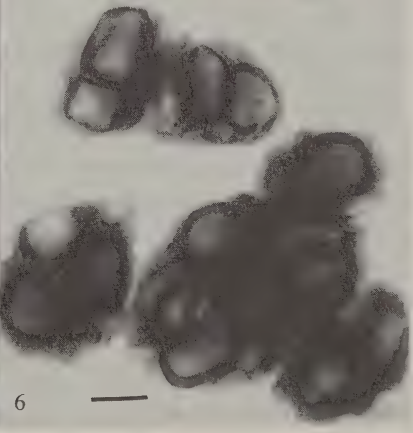

6

Sori in leaves and petioles, at first covered by the epidermis, later ruptured. Spore mass black, powdery. Spore balls subglobose, ellipsoidal, ovoid or irregular, 14-50 × 13-35 μm, composed of 1-10 ustilospores, completely or incompletely surrounded by sterile cells. Ustilospores subglobose, ovoid, ellipsoidal or irregular, 9-17 × 7-12.5 μm, yellowish-brown or blackish-brown; wall 1-2 μm thick. Sterile cells subglobose or ellipsoidal, 7.5-13 × 4.5-8 μm, yellowish-brown; wall unevenly thickened, 0.5-1.5 μm, smooth.

On *Pulsatilla chinensis* (Bunge) Regel, Qinghai: Huangcheng, 10 IX 1958, Q. M. Ma 996, HMAS 24557 (holotypus).

U. qinghaiensis differs from *Urocystis pulsatillae* (Bubák) Moesz in having more ustilospores per spore ball. The latter was described as possessing spore balls "composed of 1-5 central spores and a mostly discontinuous, sometimes continuous layer of peripheral sterile cells" (Vánky 1994).

Until now 8 species of *Urocystis* on the host family Ranunculaceae are recognized from China. They are: *U. antipolitana* Magnus (Guo 1999), *U. delphinii* Golovin (Guo 1991), *U. japonica* (Henn.) Ling, *U. irregularis* (G. Winter) Săvul., *U. pulsatillae*, *U. qinghaiensis*, *U. ranunculi* and *U. sorosporioides* Körn. ex A.A. Fisch. Waldh.

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PHYLOGENY OF AGARICS: PARTIAL SYSTEMATICS SOLUTIONS FOR BRYOPHILOUS OMPHALINOID AGARICS OUTSIDE OF THE AGARICALES (EUAGARICS)

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Abstract: The taxonomy of several species previously assigned to *Omphalina* sensu lato or *Gerronema* is reevaluated in light of recent molecularly based phylogenetic hypotheses. One surmised clade, herein informally labelled the rickenelloid clade, falls outside of the Agaricales using nLSU data. Analysis of how best to classify these taxa results in the establishment of two new genera, *Loreleia* (type: *Agaricus postii*) and *Sphagnomphalia* (type: *Clitocybe brevibasidiata*), and the renaming of a later homonym, *Jacobia* nom. illeg. as *Contumyces* (type: *Clitocybe rosella*). New combinations are proposed and an interim key to these genera is provided.

Key words: nLSU, *Omphalina, Gerronema, Rickenella, Cantharellopsis, Contumyces, Loreleia, Sphagnomphalia, Cotylidia.*

Introduction

An evolutionarily sound classification of omphalinoid and clitocyboid agarics, especially those lacking distinctive or highly developed anatomical features was virtually impossible when based solely on phenotypic characters. It may be assumed that relatively undifferentiated growth forms, such as these, arose multiple times and that taxonomic reliance upon them would result in classifications that would not reflect their phylogenetic history. Historically all such agarics were lumped together in only one or two genera (*Omphalina* Quél., *Clitocybe* (Fr.) Staude), hence the loosely applied terms omphalinoid and clitocyboid (Largent 1977), which merely refer to agarics with decurrent lamellae and either small (omphalinoid) or large (clitocyboid) basidiomata. Species with moderately sized basidiomata were left ambiguously classified. Phylogenetic analyses of nucleotide sequence data from the nuclear large ribosomal subunit RNA gene (nLSU) placed some omphalinoid agarics, e.g., *Rickenella* Raithelh., outside the Agaricales (Moncalvo et al. 2000). A more recent study (Moncalvo et al. in press) suggests that *Rickenella* and other omphalinoid fungi may be classified in an unanticipated lineage of Homobasidiomycetes, the Hymenochaetales (= hymenochaetoid clade, Hibbett & Thorn, 2001). In the present companion article to a larger phylogeny of agaricoid fungi (Moncalvo et al. in press), we conduct a new phylogenetic analysis of nLSU sequences from omphalinoid agarics and representatives of all major homobasidiomycete lineages, outline a new classification, and delimit several lamellate genera that possibly classify in the Hymenochaetales.

Re-investigation of published phylogenetic data

Lutzoni (1997), when investigating lichenized versus nonlichenized omphalinoid agarics using four datasets (ITS1, 5.8S, ITS2, and nLSU), demonstrated that several taxonomically problematic bryophilous taxa [labelled *Gerronema marchantiae* Singer & Clémençon, *Omphalina brevibasidiata* (Singer) Singer, *O. rosella* (M.M. Moser) M.M. Moser, *Rickenella mellea* (Singer & Clémençon) Lamoure, and *R. pseudogrisella* (A.H. Sm.) Gulden] clustered together away from the majority of the other omphalinoid taxa in a limited sampling of agarics (23 species; 1 purported outgroup = *Multiclavula* R.H. Petersen). He pondered whether all five problematic taxa should be considered to be congeneric and named *Rickenella*. Moncalvo et al. (2000) used only the nLSU (25S) data of only 3 representatives of that clade (*O. rosella*, *R. mellea* and *R. pseudogrisella*) and 12 additional species from Lutzoni (1997) as a subsample, but combined these data with a far more diverse taxon data matrix (139 other taxa, mostly agarics). They suggested that these three problematic bryophilous taxa (labelled clade "X" in their fig. 2) formed a monophyletic group outside of the main agaric clade, i.e., outside the Agaricales or euagarics. Subsequently, as the 154-taxon-sized data matrix utilized by Moncalvo et al. (2000) grew in size through the addition of taxa, it was learned serendipitously that *Cotylidia aurantiaca* (Pers.) A.L. Welden clustered with taxa in clade "X", as did *Cantharellopsis prescotii* (Weinm.) Kuyper. The latter species is yet another bryophilous omphalinoid agaric (Redhead 1984; Kuyper 1986; Bigelow 1985), whereas *Cotylidia aurantiaca* is terrestrial and has been considered to be a stipitate stereoid taxon (Reid 1965) in the Podoscyphaceae ("Aphyllophorales").

Consequently, 2 additional species of *Cotylidia* P. Karst., *C. aurantiaca* var. *alba* Reid and *C. diaphana* (Schw. apud. Berk. & Curt.) Lentz, were added to the expanding taxon matrix for analysis by Moncalvo et al. (in press), in order to test for fidelity of the sequence data at the generic level for the characteristically monomitic genus *Cotylidia*. Additionally, a representative of the dimitic genus *Podoscypha* Pat., *P. parvula* (Lloyd) Reid, was added to the data set to test for taxonomic and phylogenetic relationships that nomenclaturally might affect the use of the names Podoscyphaceae and Podoscyphales. Results showed that *Podoscypha parvula* belongs to a distant clade, which can be called the Polyporales (= polyporoid clade, Hibbett & Thorn 2001) and is also equivalent to outgroup "BB" in Moncalvo et al. (2000). In all current bootstrap and maximum parsimony analyses of LSU sequence data (Moncalvo et al., in press), all three *Cotylidia* mentioned above cluster in close proximity with each other and with *Rickenella* representatives and other allies. It is possible that the genus *Cotylidia* is also bryophilous. Its biology has not been examined in detail. Lammers (1992) reports that *Cotylidia undulata* (Fr.: Fr.) P. Karst. grows among pioneering vegetation, including the mosses *Bryum argenteum* Hedw. and *Pohlia nutans* (Hedw.) Lindb. and Moncalvo (pers. obs.) collected the sequenced sample of *C. aurantiaca* on mosses on a decaying coconut stump. Curiously, nLSU data (Moncalvo et al., in press) also suggests a relationship of these taxa and the lignicolous taxa *Resinicium bicolor* (Alb. & Schwein.) Parmasto (a corticioid), *Trichaptum abietinum* (Dicks.: Fr.) Ryvarden (a polypore), and *Hyphodontia radula* (Pers.) Langer & Vesterh. (a corticioid). However, there is somewhat conflicting published ITS1-5.8S-ITS2 data suggesting that *Cotylidia diaphana* is related to species of *Phanaerochaete* P. Karst. (Boidin et al. 1998), a genus which LSU data available to us suggests is more closely allied to most *Phlebia* Fr. species, in the polyporoid clade of Hibbett & Thorn (2000). As a result, until resolved by further study, it is difficult to assign either a family or order name for the group that includes the genera *Rickenella* and *Cotylidia*. The Podoscyphaceae does not appear to be appropriate because in all analyses of the nLSU data, the type genus, *Podoscypha*, clusters elsewhere. Based solely on the analysis by Moncalvo et al. (2000) it would be tempting to name a new family for *Rickenella* and allies. However, for classification purposes, we now would include several previously described genera (*Cantharellopsis* Kuyper, *Cotylidia*, *Rickenella*) and tentatively excluding genera such as *Hyphodontia* J. Erikss., *Resinicium* Parmasto, and *Trichaptum* Murrill, while noting that *Phlebia tristis* (Litsch. & S. Lundell) Parmasto possibly has affinity to the group. However, Hibbett et al. (1997) have demonstrated that *Trichaptum abietinum* and *Hyphodontia alutaria* (Burt.) J. Erikss. belong to a clade that Hibbett & Thorn (2001) named the hymenochaetoid clade. That clade included genera traditionally placed in the Hymenochaetaceae (*Coltricia* Gray, *Phellinus* Quél., *Inonotus* P. Karst.), as well as *Schizopora* Vel. (Schizoporaceae Jülich 1981), *Basidioradulum* Nobles (Hyphodermataceae Jülich 1981), and *Oxyporus* (Bourdot & Galzin) Donk sp. (Rigidiporaceae Jülich 1981). Thus there is no shortage of potential family names in this unresolved large clade for which we adopt the name Hymenochaetales.

Here we conduct a new phylogenetic analysis of nLSU sequences in order to examine in more details the relationships of omphalinoid agarics that classify outside the Agaricales, and further test their possible affinities with hymenochaetoid taxa. To do this, we combined sequences taken from Moncalvo et al. (2000 and in press) with several hymenochaetoid sequences that have recently been deposited in GenBank by E. Langer. We propose here several new genera and combinations for omphalinoid agarics.

Materials and methods

The data matrix for this study consisted of 47 nLSU sequences representative of the eight major clades of Homobasidiomycetes as determined in Hibbett & Thorn (2001) and Binder & Hibbett (in press). A sequence of *Auricularia polytricha* (Mont.) Sacc. (Heterobasidiomycetes) was used to root the phylogeny. The GenBank accession number of each sequence is given after each taxon name in Fig. 1. Sequences were aligned manually. Phylogenetic analysis was conducted in PAUP* version 4.0b6 (Swofford 1999) using maximum-likelihood (ML) as the optimality criterion. ML settings were determined by likelihood-ratio tests (LRT) in MODELTEST vs. 3.06 (Posada & Crandall, 1998). A heuristic search was conducted with ASIS addition sequence, TBR branch swapping, and MULTREES on. Statistical support for nodes in the phylogeny were evaluated from 500 bootstrap replicates using maximum-parsimony with the following settings: one round of random addition sequence in each replicate, TBR branch swapping, steepest descent not in effect, branch allowed to collapse when maximum branch length was zero (amb = -), MULPARS on, and MAXTREES set to 10 in each replicate.

We conducted a search that constrained the omphalinoid agarics to be monophyletic, and compared the resulting constrained trees with unconstrained trees using the Shimodaira-Hasegawa (SH) test in PAUP*. The SH test was performed using 1000 bootstrap replicates for RELL and full optimization.

Results and discussion

Phylogenetic analysis

The 48 sequences were unambiguously aligned for 868 positions, of which, 459 were constant, 125 were variable but parsimony-

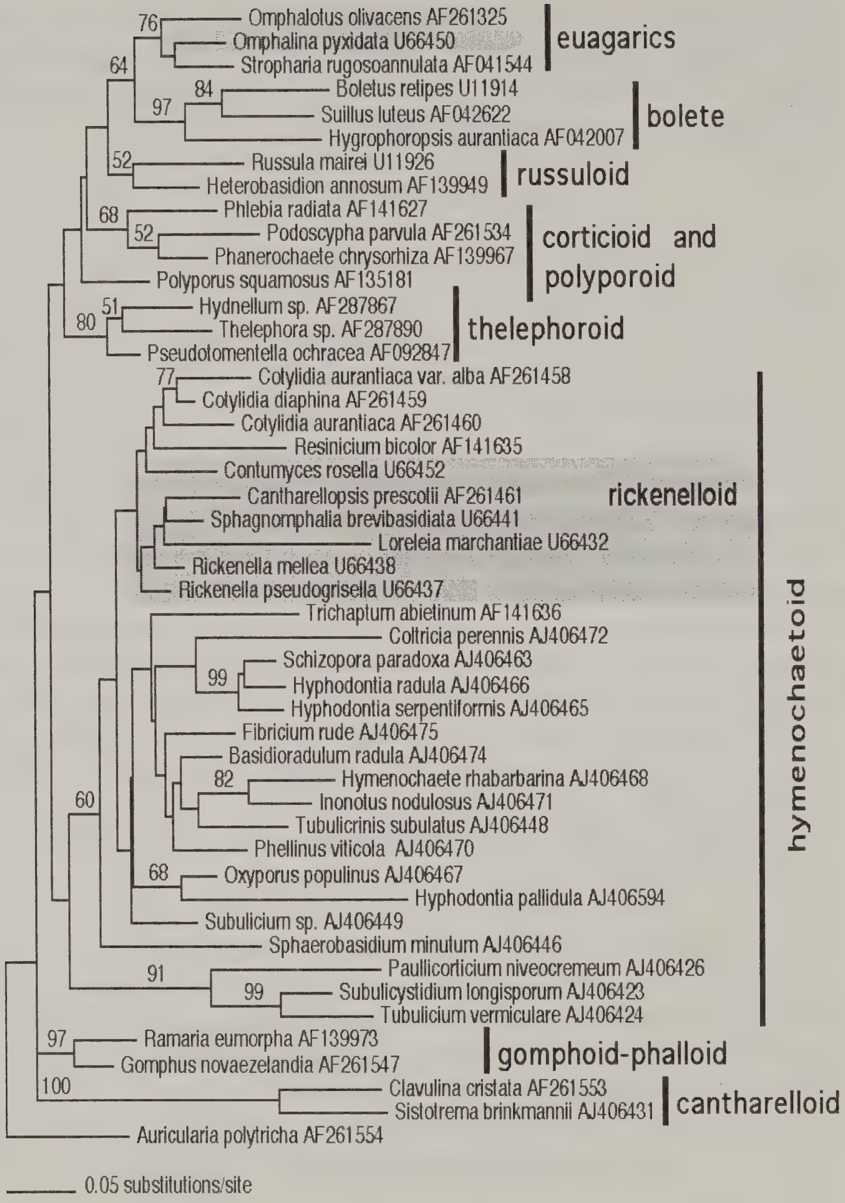
76
Omphalotus olivacens AF261325
Omphalina pyxidata U66450
Stropharia rugosoannulata AF041544
euagarics
64
84
Boletus retipes U11914
97
Suillus luteus AF042622
Hygrophoropsis aurantiaca AF042007
bolete
52
Russula mairei U11926
Heterobasidion annosum AF139949
russuloid
68
Phlebia radiata AF141627
52
Podoscypha parvula AF261534
Phanerochaete chrysorhiza AF139967
Polyporus squamosus AF135181
corticioid and polyporoid
51
Hydnellum sp. AF287867
80
Thelephora sp. AF287890
Pseudotomentella ochracea AF092847
thelephoroid
77
Cotylidia aurantiaca var. alba AF261458
Cotylidia diaphina AF261459
Cotylidia aurantiaca AF261460
Resinicium bicolor AF141635
Contumyces rosella U66452
Cantharellopsis prescotii AF261461
Sphagnomphalia brevibasidiata U66441
Loreleia marchantiae U66432
Rickenella mellea U66438
Rickenella pseudogrisella U66437
rickenelloid
Trichaptum abietinum AF141636
Coltricia perennis AJ406472
Schizopora paradoxa AJ406463
99
Hyphodontia radula AJ406466
Hyphodontia serpentiformis AJ406465
Fibricium rude AJ406475
Basidioradulum radula AJ406474
82
Hymenochaete rhabarbarina AJ406468
Inonotus nodulosus AJ406471
Tubulicrinis subulatus AJ406448
60
Phellinus viticola AJ406470
68
Oxyporus populinus AJ406467
Hyphodontia pallidula AJ406594
Subulicium sp. AJ406449
Sphaerobasidium minutum AJ406446
91
Paullicorticium niveocremeum AJ406426
99
Subulicystidium longisporum AJ406423
Tubulicium vermiculare AJ406424
hymenochaetoid
97
Ramaria eumorpha AF139973
Gomphus novaezelandia AF261547
gomphoid-phalloid
100
Clavulina cristata AF261553
Sistotrema brinkmannii AJ406431
cantharelloid
Auricularia polytricha AF261554
0.05 substitutions/site

Fig. 1. One of 3 ML trees discussed in text, showing the surmised placement of the rickenelloid fungi in the hymenochaetoid clade and the type species for *Omphalina* in the euagarics clade.

uninformative, and 284 were variable and parsimony-informative. LRT in MODELTEST suggested the use of the TrN+I+G model of evolution for ML analysis, as follows: Base frequencies: A = 0.2654, C = 0.1804, G = 0.2949, and T = 0.2593; substitution model (rate matrix): [A-C] = [A-T] = [G-T] = 1.0000; [A-G] = 3.5597; and [C-T] = 8.1045; proportion of invariable sites = 0.3625; gamma shape parameter for variable sites = 0.5908; and 4 rate categories. With these settings, the ML search produced three trees of score – ln = 9604.30157. One of these three trees is shown in Fig. 1, along with parsimony-based bootstrap statistical support for branches. A search that constrained *O. pyxidata* (Pers.: Fr.) Quél., type of *Omphalina*, to form a monophyletic group with the omphalinoid taxa nested within the hymenochaetoid clade produced a tree of score –ln = 9696.17366. Based on the SH test, this constrained topology was significantly less-likely than the unconstrained tree ($P < 0.001$), and this hypothesis could therefore be rejected.

The tree depicted in Fig. 1, although produced from partial nLSU sequences, is largely congruent with the phylogeny of Binder & Hibbett (in press) who combined sequence data from 4 ribosomal genes and proposed the recognition of eight major homobasidiomycete lineages (Hibbett & Thorn, 2001).

As in the 877 taxa analysis in Moncalvo et al. (in press), the analyses conducted here placed *Rickenella mellea, R. pseudogrisella, "Omphalina" marchantiae, "O." brevibasidiata, "O." rosella* and *Cantharellopsis prescotii* in the hymenochaetoid clade, with moderate bootstrap statistical support (60 %, versus 68 % in Moncalvo et al.). These taxa are well separated from the type species of *Omphalina, O. pyxidata*. The latter species unequivocally belongs to the euagarics clade (Agaricales), which is moderately well supported as a sister group to the bolete clade (Boletales) (64 % bootstrap support). The latter relationships were first shown convincingly (90 % bootstrap support) in the multi-gene analysis by Binder & Hibbett (in press).

Taxonomy

Among the sampled omphalinoid taxa classified outside the Agaricales, the number of taxa to be recognized at a generic level is debatable. All of the taxa discussed above fall within a weakly supported clade in the neighbourhood of *Cotylidia* and *Resinicium bicolor*. We draw upon the data published by Lutzoni (1997) and Moncalvo et al. (2000 & in press) for guidance. "*Gerronema*" *marchantiae* exhibited the greatest amount of divergence among the omphalinoid taxa studied by Lutzoni (1997). Throughout his analyses, using pruned and unpruned 25S, ITS1 and ITS2 data, separately or combined (and using equally or unequally weighted parsimony or maximum likelihood methodologies), the placement of *G. marchantiae* was unstable in the resulting tree topologies. We surmise that the species should not be amalgamated with *Rickenella* because of the gross divergence in nucleotide sequence data complemented by anatomical data. *Gerronema marchantiae* and the closely allied species, *Omphalina postii* (Fr.: Fr.) Singer (*Gerronema postii* (Fr.: Fr.) Singer) lack evenly distributed leptocystidia that characteristically cover all surfaces in *Rickenella*. It has already been argued that *Gerronema* sensu stricto, as typified by a lignicolous species with sarcodimitic tissues, is not an appropriate generic disposition (Redhead 1986, Norvell et al. 1994) for *O. marchantiae* (Singer & Clémençon) Norvell, Redhead & Ammirati and *O. postii*. Representatives of *Gerronema sensu stricto* (*G. strombodes* (Berk. & Mont.) Singer, *G. subclavatum* (Peck) Redhead) in fact cluster elsewhere (Lutzoni 1997, Moncalvo et al. 2000, and in press). Pending phylogenetic studies utilizing DNA sequence data and settlement of the typification of the name *Omphalina*, Norvell et al. (1994) adopted a conservative position and transfered *G. marchantiae* to *Omphalina* rather than create a new genus. The lectotype for the generic name *Omphalina* is now conserved as *O. pyxidata* (Pers.: Fr.) Quél (Greuter et al. 2000). The placement of *Omphalina pyxidata* well within the Agaricales (euagarics) clade, far removed from *Rickenella* and *Gerronema/Omphalina marchantiae*, is strongly supported (Moncalvo et al. 2000; and in press). In the absence of an appropriate generic name, we propose a new genus, *Loreleia* gen. nov. (see below), for the two nearly identical species, *L. marchantiae* comb. nov. and *L. postii* comb. nov. Both species form clampless, orange basidiomata (pigmented by unknown noncarotenoid parietal pigments, Kühner 1980) and are seemingly obligately associated with living bryophytes (mosses and/or liverworts).

Currently we also prefer not to include "*Omphalina*" *brevibasidiata* in *Loreleia* or to include "*Omphalina*" *rosella* in either *Loreleia* or *Rickenella*. *Omphalina brevibasidiata* in Lutzoni's (1997) combined analyses (his fig. 7) appeared in a clade near *Loreleia marchantiae*, but that inferred relationship is poorly supported by the combined Maximum Likelihood bootstrap analysis (BS = 64%) and was not recovered by his two combined Maximum Parsimony analyses. When additional taxa such as *Cantharellopsis prescotii* are added to LSU analyses of larger taxon data sets, monophylly of a smaller clade combining *Loreleia marchantiae* and "*Omphalina*" *brevibasidiata* is not supported (Moncalvo et al. in press). Additionally, there are slight anatomical and biological differences. *Omphalina/Clitocybe/Gerronema brevibasidiata* is lightly pigmented (not orange), forms clamped hyphae, is sphagnicolous, and lacks well differentiated caulocystidia (Redhead 1985). These differences, albeit subtle, compliment the large base pair divergence, which suggests to us that maintaining separate genera is in actuality a more conservative and prudent option than lumping both taxa together in one genus. Unknown to everyone, including Lutzoni (1997), other taxa such as *Cantharellopsis prescotii* and *Cotylidia* spp. prove to be related and their inclusion affects the approximations of relationships in larger analyses. The even more disparate corticoid and polyporoid taxa skew relationships further. As a solution, we propose the monotypic genus *Sphagnomphalia* gen. nov. for *S. brevibasidiata* comb nov. (see below).

Anatomically, because of the abundance of leptocystidia, *Omphalina rosella* exhibits the greatest affinity to *Rickenella* as noted by Redhead et al. (1995), and corroborated by ITS and LSU data (Lutzoni 1997), but the circumscription of the latter genus would require alteration to accommodate *O. rosella*, even while it remains uncertain that *O. rosella* is the closest relative to *Rickenella* (BS = 56% with combined ML analyses in Fig. 7 of Lutzoni 1997). To lesser extent than *Loreleia marchantiae*, *O. rosella* drifts in the various analyses (Lutzoni 1994, Moncalvo et al. 2000, and in press). Contu (1997) erected the genus, *Jacobia* Contu typified by *O. rosella*, basing separation of the genus on the irregular lamellar trama. He included two other species which have yet to be molecularly analysed, *J. brunneolilacina* (Contu, M. Bon & L. Curreli) Contu and *J. vesuviana* (Briganti) Contu. Unfortunately the name *Jacobia* Contu is a later homonym of *Jacobea* Thunb. 1801 (Asteraceae), and possibly of *Jacobaea* P. Miller 1754 and *Jacobaea* Gärtn. 1791. Therefore, we propose the nomen novum *Contumyces* for *Jacobia* Contu, typified by *C. rosella* comb. nov.

Interim key to terrestrial pileate genera of the hymenochaetoid clade (all nonamyloid, smooth, white-spored fungi)

1. Lamellae present as discrete plates or forked well-formed ridges; bryophilous; clamp connections present or absent **2**

1. Lamellae absent, or hymenium merely rugose; bryophilous or possibly merely terrestrial; clamp connections absent **6**

2. Clamp connections absent; pleurocystidia absent **3**

2. Clamp connections present; pleurocystidia present or absent **4**

3. Basidiomata bright orange, hymenium clearly lamellate (only occasionally forked once) . . . . ***Loreleia***

3. Basidiomata nearly white, with tan colored center; hymenium cantharelloid (a series of repeatedly forked folds) . . ***Cantharellopsis***

4. Pileo-, caulo- and cheilocystidia abundant, similar to each other, well differentiated, and projecting conspicuously; basidiomata (esp. pileus and stipes) strongly pigmented (brightly colored [orange, pink, violet] or honey brown over all); not on living *Sphagnum* **5**

4. Pileo- and cheilocystidia absent and caulocystidia restricted to a few clavate ends near the stipe apex; basidiomata (esp. lamellae and stipes) pallid to whitish, pigment restricted to a yellowish-brown disc area; on living *Sphagnum* . . . . ***Sphagnomphalia***

5. Pileo-, caulo-, cheilo- and pleurocystidia abundant and evenly spaced over each surface (or somewhat grouped on stipes), lacking crystalline deposits of vinaceous pigment on the caulocystidia and elsewhere; lamellar trama regular . . . . ***Rickenella***

5. Pileo- and caulocystidia initially in solid turfs, on the pileus remaining aggregated into small clusters collapsing on the surface, on the stipe becoming scattered but many remaining in clusters (minute scales); the type bearing rosy to vinaceous crystalline deposits forming on scales on stipes [deposits easily dislodged, tending to disolve in KOH or alcohol solutions]; lamellar trama irregular becoming bidirectional . . . . **Contumyces**

6. Basidiomata stipitate, pallid to brightly pigmented; fleshy from inflated context hyphae; terrestrial usually on mineral soils but often among mosses; hymenial cystidia often secondarily septate . . . . **Cotylidia**

6. Basidiomata stipeless or only vaguely pseudostipitate via a lateral fold; usually fruiting directly on mosses (often Polytrichaceae), or adjacent mineral soil on exposed soil banks; basidiomata membranous and easily obliterated (hyphae tending not to be inflated) . . . . **Cyphellostereum** (presumed relationship, sequence data not available)

New genera and new combinations

Contumyces *gen. et nom nov. (f.)*

Basionym (Latin diagnosis): *Jacobia* Contu, Bollettino del Gruppo Micologico G. Bresadola N.S. 40(2-3): 170. 1997. Nom. illeg. (ICBN Art. 53.3) non *Jacobea* Thunb. (Asteraceae), Nov. gen. XIII p. 169. 1801.

Etyomology: Named after Marco Contu, in recognition of his work on this genus.

Typus: ***Contumyces rosella*** **(Moser) comb. nov.** Basionym: *Clitocybe rosella* Moser, Sydowia 4: 100. 1950. *Nom. nov. ut* "*Clitocybe rosella* (Lange) Moser comb. nov." (ICBN 58.1, ex 1) for *Omphalia rosella* J. Lange, Dansk. Bot. Ark. 6: 14. 1930, *nom. illeg. non Omphalia rosella* (Batsch) S.F. Gray, Nat. Arrang. Brit. Pl. 1: 813. 1821.

Selected literature: Candusso et al. (1994- *Omphalina rosella)*, Clémençon (1982- *Omphalina rosella*), Bas et al. (1995- *Marasmiellus rosellus*), Contu (1997- *Jacobia rosella*), Kuyper (1986- *Marasmiellus rosellus*), Lutzoni (1997- *O. rosella* [phylogeny]), Lutzoni & Pagel (1997- *O. rosella* [evolutionary biology]), Redhead et al. (1995- *Omphalina rosella*), Robich (1998- *Omphalina rosella*).

Other species (fide M. Contu, 1997):

C. brunneolilacina **(Contu, M. Bon & L. Curreli) comb. nov.** Basionym: *Rickenella brunneolilacina* Contu, M. Bon & L. Curreli, Micol. e Veget. Mediterr. 4: 58. 1989.
Selected literature: Contu (1997 - *Jacobia brunneolilacina*)

C. vesuviana **(Briganti) comb. nov.** Basionym: *Agaricus vesuvianus* Briganti, Hist. Fung. Regni Neapol. p. 115. 1848.
Selected literature: Contu (1997- *Jacobia vesuviana*), Malençon & Bertault (1975- *Omphalina vesuviana*).

Loreleia *gen. nov. (f.)*

Basidiomata omphaliforma, aurantiaca. Non lichenisata. Muscicola vel hepaticola. Trama lamellarum bidirectionalis; hyphis inamyloideus, defibulatis; cystidia nulla. Sporis albis, inamyloideus.
Etyomology: Named in honor of Lorelei L. Norvell for work on omphalinoid agarics.
Type: ***Loreleia postii*** **(Fr.) comb. nov.** Basionym: *Agaricus postii* Fries, Monogr. Hymenomyc. Sueciae 2: 291. 1863.
Selected literature: Clémençon (1982- *Gerronema postii*), Klán (1992 - *G. postii* - ecology, descriptions), Senn-Irlet et al. (1990- *G. postii*), Wark (1997 - *G. postii* - ecology)
Other species: ***L. marchantiae*** **(Singer & Clémençon) comb. nov.** Basionym: *Gerronema marchantiae* Singer & Clémençon, Schweiz. Z. Pilzk. 49: 119.1972.
Selected literature: Clémençon (1982- *Gerronema marchantiae*, *G. daamsii*), Klán (1992 - *G. marchantiae*), Lutzoni (1997- *G. marchantiae* [phylogeny]), Lutzoni & Pagel (1997- *G. marchantiae* [evolutionary biology]), Senn-Irlet et al. (1990- *G. marchantiae*), Watling (1988- *G. marchantiae*).
L. roseopallida **(Contu) comb. nov.** Basionym: *Gerronema roseopallidum* Contu, Mycol. Helvetica 3(2): 216-217. 1988. Described as being pale orange centrally but otherwise pale pinkish, lacking clamp connections, lacking cystidia, and growing in xeric habitats on acidic soils. The presence of bryophytes was not mentioned. Additionally it lacks sarcodimitc tissues (Contu 1990).

Sphagnomphalia *gen. nov. (f.)*

Basidiomata omphaliforma, straminea vel pallida. Non

lichenisata. Sphagnicola. Trama lamellarum bidirectionalis; hyphis fibulatis, inamyloideus; cystidia nulla. Sporis albis, inamyloideus.
Etyomology: Named for its habitat (*Sphagnum*) and its omphalinoid habit, and deliberately spelled in this abbreviated manner.
Type: ***Sphagnomphalia brevibasidiata* (Singer) comb. nov.**
Basionym: *Clitocybe brevibasidiata* Singer, Ann. Mycol. 41: 45-46. 1951.
Selected literature: Clémençon (1982- *Gerronema brevibasidiatum*), Kubička (1956- *Omphalia cincta*), Lutzoni (1997- *Omphalina brevibasidiata* [phylogeny]), Lutzoni & Pagel (1997- *O. brevibasidiata* [evolutionary biology]), Redhead (1985- *Omphalina brevibasidiata*).

Notes on other genera

***Cantharellopsis* Kuyper**, specifically *C. prescotii* (Weinm.) Kuyper (1986).
Selected literature: Bigelow (1985 - as misapplied name *Hygrophoropsis albida*), Clémençon (1982- *Gerronema albidum*), Corner (1966- as misapplied name *Hygrophoropsis albida*), Horak (1987- *Cantharellus prescotii*), Kuyper (1986), Ohenoja & Vare (1994 - as *Gerronema prescotii* (Wienm.) Redhead - ecology), Redhead (1984- as *G. prescotii*, Watling & Turnbull (1998- as *G. prescotii*).

There is a question regarding the generic and specific identity of another bryophilous taxon, *Pterygellus polycephalus* (Bres.) Redhead. Some European collections identified as either *Cantharellus polycephalus* Bres. or *Leptoglossum polycephalum* (Bres.) M. M. Moser are undoubtedly *C. prescotii* (Redhead 1984), but the type of *C. polycephalus* had a tougher consistency composed of thicker-walled hyphae with acyanophilous walls and they formed pyxidately pileate basidiomata with tomentose stipes (Redhead 1984). The differences in cyanophily of the thicker walled hyphae was believed to be significant and the two taxa were kept generically separated by Redhead (1984). Horak (1987) synonymized the two species, which begs the question regarding possibly synonymy of *Cantharellopsis* Kuyper (1986) with *Pterygellus* Corner (1966).

Horak (1987) overlooked comments on the cyanophily of the hyphal walls, hence his synonymy of the two taxa is still questionable. It is conceivable that *P. polycephalus* is an older growth form of *C. prescotii*, in which the stipes become overgrown (tomentose), the hyphal walls thicken by deposition of acyanophilous materials, and there is rejuvination and regrowth of the pilei marginally on older pilei (i.e., pyxidately). Further studies of living populations and/or DNA studies are suggested to resolve the identities of these intriguing fungi. Additionally, although *Cantharellus polycephalus* was transfered to *Pterygellus*, the delimitation of that genus and its biological status also requires investigation. The question of whether or not some *Pterygellus* are mycorrhizal (with *Euphoria*) has been raised (Verbeken 1999).

Cotylidia P. Karst.

Selected literature: Lammers (1992 [ecology]), Reid (1965 [type studies, ecology]).

Cyphellostereum D. Reid

Selected literature: Corner (1966- *Leptoglossum laeve*), Høiland (1976), Keizer & Arnolds (1994 [ecology]), Kuyper in Bas et al. (1995), Redhead (1984 [type studies, ecology]), Reid (1965 [type studies, ecology]), Watling & Gregory (1989).

Rickenella Raithelh.

Selected literature: Clémençon (1982), Gulden et al. (1985), Kost (1984 [parasitism demonstrated], 1986 [parasitism demonstrated]), Kuyper in Bas et. al. (1995), Lamoure (1979 [cultures]), Lutzoni (1997), Lutzoni & Pagel (1997), Norvell et al. (1994), Redhead (1980 [parasitism demonstrated as *Gerronema*], 1981 [parasitism demonstrated as *Gerronema*], 1986), Senn-Irlet et al. (1990), Treu & Agerer (1990 [cultures]).

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FAVOLASCHIA CALOCERA, A TROPICAL SPECIES COLLECTED IN ITALY*

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Key words: *Favolaschia,* taxonomy, new collection, Europe

Abstract

This paper focuses on some specimens of *Favolaschia calocera* found for the first time in Italy and, probably, in Europe. A detailed descriptions is given of the collecting areas, the micro- and macroscopic characteristics of the species. The taxonomical position of the genus *Favolaschia* is also discussed along with some hypotheses about the diffusion in Northern Italy of this pan-tropical genus.

Introduction

In 1999, a very peculiar species, *Favolaschia calocera* R. Heim ex R. Heim, was found and collected in a park in Genoa, Italy. According to the current literature, our find is the first one recorded in Italy, but also in Europe.

This paper provides 1) a description of the habitats where the species was collected in Italy; 2) the material and methods used for the study; 3) illustrations for both micro- and macroscopic characters of *Favolaschia calocera*; 4) a complete comparison with the taxonomically related species;

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5) a hypothesis on the mechanism involved in the species spreading and arrival in Italy.

Collecting locations and habitats

Favolaschia calocera was found in Liguria, a northwestern region of Italy with very peculiar geomorphologic and climatic characteristics that allow numerous plant species to be found (Liguria is the richest in terms of regional flora, Pignatti & Pignatti 1992) and diverse habitats to co-exist: deciduous forest alternates with sclerophyllous woods, as well as beaches with rockroses and maquis... The habitats diversity correlates with a diversity of mycological taxa: although only a limited portion of the region has been studied, a total of 1521 Macrofungi has been recorded at present (Zotti & Orsino, 2001).

Liguria is a boundary region between two different climatic areas: the Mediterranean and central Europe, facing the Mediterranean Sea while a mountain chain develops parallelly and generally very close to the coastline (the highest peak is Mt. Saccarello -2200 m). The average annual rainfall ranges from 702 mm on the far western coast to 2500 mm in eastern Liguria. The average annual temperature ranges from 16.6 °C on the western coast to 9.2 °C in the higher inland zones. The overall coastal bioclimate is essentially Mediterranean and sub-Mediterranean on the western and eastern coasts, respectively. More details on Ligurian bioclimate can be found in Gentile, 1982, 1986 and Vagge 1999.

The two areas where *Favolaschia calocera* was recorded are located at the suburbs of Genoa, the region's capital, both in the littoral plane and about 6 kms one from the other.

The average rainfall data (from "Hydrological Annals"; Hydrographic Regional Service) as measured at the nearest Weather Stations are 1321.2 mm (per year) and 328 (spring), 167.9 (summer) and 525 mm (autumn). As to the temperature, the annual averages are 13.2 (minimum), 18.7 (medium) and 16 °C (maximum). The average seasonal temperatures are 14.4 (spring), 23.1 (summer) and 8.8 °C (autumn).

Some details for each of these two places may be added:

- the first one is located in Multedo (a suburb of Genoa), in the park of an old villa (Villa "Chiesa-Ansaldo"), now partially destroyed. The park covers approximately three hectares and is completely unmanaged. Some vegetals are dominant and form a tangled wood where plants grow wild without any gardening management. Consequently, all ornamental species as well as the park structure have been lost. The only exception is some specimens of *Phoenix* spp. The tree layer is discontinuous and includes *Robinia pseudoacacia* L., with specimens taller than 20 m; a second, lower tree layer is formed by younger Robinas, *Fraxinus ornus* L., *Sambucus nigra* L., and *Laurus nobilis* L.. The shrub layer is very thick and consists of

Ligustrum lucidum Ait., *Sambucus nigra* L., *Laurus nobilis* L. and *Clematis vitalba* L.. Finally, the herb layer is absent in the woody zone and is only present along the few paths that can still be utilized. Thanks to the thickness of the lower tree and shrub layers, the soil retains a high amount of moisture. The extended lack of human management has led to the accumulation of large amounts of organic material with different levels of decomposition.

- many aspects of the second place are similar. It covers approximately one hectare and is located in a narrow, short valley of a brook. Twenty years ago this valley was an agricultural area and today *Robinia* and *Alnus* dominate all the other species, forming a thick and continuous tree cover. The shrub layer is very thick and consists of *Robinia, Sambucus, Alnus, Rubus* and *Clematis.* There is a large amount of organic material at the soil level.

Material and methods

Complete macro- and micromorphological descriptions of fresh collections form the basis of this taxonomic study.

The color notations (into brackets) were taken from Kornerup & Wanscher (1978). Microscopic examinations of fresh material were made in aqueous Congo red, Cresyl blue and Melzer's reagent. Spore measurements were made from deposits whenever possible (n=21-25). Abbreviations used to describe the basidiospore measurements include Q= quotient of spore length to spore width. The macroscopic and microscopic sizes are reported using three numbers corresponding, respectively, to the minimum, the average and the maximum values of a set of measurements.

Description

Macroscopic characters

Basidioma pileate, deep orange (6 A8-7; 5 A8), sessile to stalked. Development stipitocarpic.

Pileus 3.5/8/15 mm in diameter, applanate convex, semicircular or reniform, thin wavy margin and slightly festoon like; opaque cuticle, deep orange (5 A8; 6 A8-7) with weak pastel red (7 A5-6) shades. It has small protuberances that resemble the surface of a raspberry corresponding to the pores of the hymenophore tubes. **Hymenophore** formed by adnate tubes with more or less irregular elongated honeycomb-like pores, wider near the stipe (up to 2 mm extended radially), smaller near the pileus margin (1 mm), concolorous with the pileus surface. Dissepiments partially covered by pruinose thin layers, from whitish to bright orange. **Stipe**: 2 /12/20 x 1/1.3/1.6 mm, cylindrical, very short and curved, in the reflected specimen, concolorous or more yellowish with respect to the pileus surface. **Context**: yellow, scarce, not very elastic, inodorous, tasteless. **Spore-print**: white.

Microscopic characters (**Fig.1**)

Spores 10/11.6/13.5x5/6.7/8.5 μm, average Q=1.7, of differently shaped from widely oval to subcylindrical, smooth and amyloid. **Basidia** 2-spored 55/62.5/65x9/10/12 μm, much like those of the *Dacrymycetales* (*inde nomen*) order, sterigmata up to 12.5 μm. **Cheilocystidia** 25/57/70 x 8/10/16 μm very numerous, with different shapes: cylindrical, sub-cylindrical, clavate, pear-shaped; typically more or less covered by diverticules up to 1 μm. **Caulocystidia** 5/7,5/12,5 x 28/50/75 μm, subcylindrical, smooth and clustered. **Gloeocystidia** 10/16/22.5x25/45/70 5/7,5/12,5x28/50/75 μm, numerous, present in whole basidioma, clavate, pear-shaped, thick-walled, with oily refringent contents, generally golden yellow. Gloeocystidia show a general cresyl blue metachromasy. **Pileipellis** closely textured with different elements: pear-shaped, smooth or diverticulated cells and gloeocystidia. **Clamp connections** not observed.

Substrate

Growing in large groups on fallen twigs and branches of *Robinia pseudoacacia* and *Sambucus nigra*.

Specimens examined: i) "Parco della Villa Chiesa-Ansaldo" in Genoa, Multedo of Pegli, 10 m above sea level, 25 April 1999, 24 September 1999, 27 October 1999, 28 October 1999, 11 November 1999, legit Franco Ronchi; 27 October 2000, legit Mido Traverso; ii) Murta, Genoa, Genoa-Bolzaneto, 400 m above sea level, 27 October 2000, 7 November 2001, legit Fabrizio Boccardo. (cartographic reference: Regional Technical Cartography, scale 1:50.000, table no. 213-230).

Exiccata are deposited in the Natural Science Museum of Genoa.

Discussion

Generic definition and position

Favolaschia (Pat.) Pat. is a typical pan-tropical genus (Singer 1945, 1974): Singer (1974) describes about fifty species in a monograph dedicated to this genus. The generic macroscopic characters are quite peculiar which make identification easy. The species, both sessile and stipitate, has a typical poroid hymenophore with a *Mycena*-, *Crepidotus*- or *Auriscalpium*-like habitus, white or brightly colored from yellow to orange basidiomata, amyloid spores, gloeocystidia and diverticulated cystidia (acanthocysts). Most species are saprotrophic and grow on vascular plant debris (Pteridophytes, Conifers, Monocotyledons and Dicotyledons).

At the moment, the systematic placement of *Favolaschia* is uncertain: Singer (1969) published the new monotypic family *Favolaschiaceae* for this genus. According to Buyck (1998), who agrees with Singer's hypothesis (1974, 1986), the genus should be ascribed to *Aphyllophorales s.l.* near *Aleurodiscus*. Instead, Heim (1945) and Patouillard (1900) see some affinity with *Marasmius* and, consequently, with *Agaricales s.l.*. Parmasto (1999)

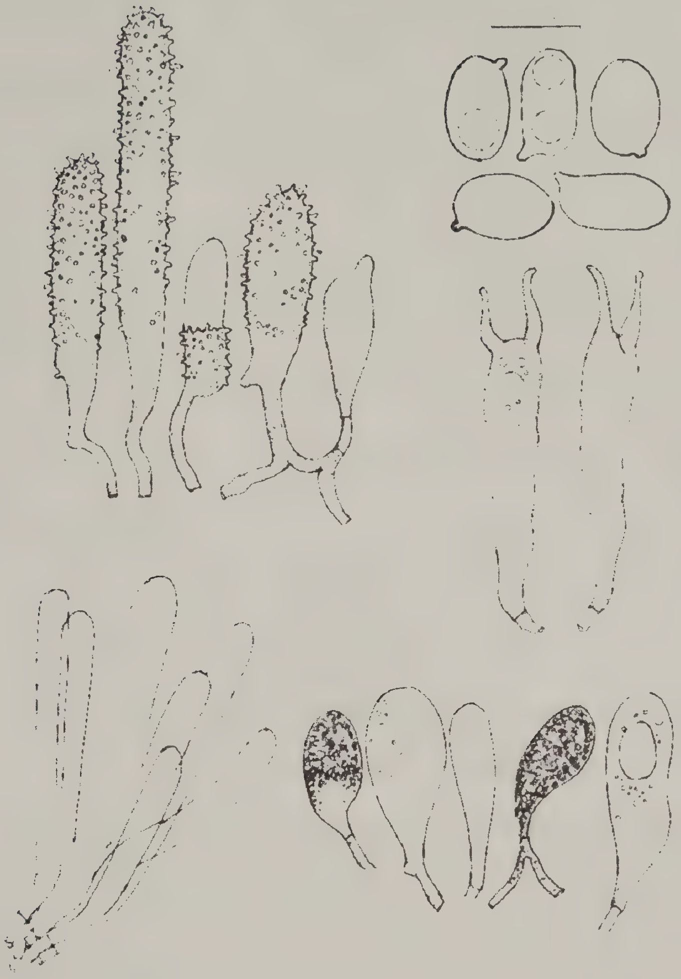

Fig. 1. Microscopic characters (spores, basidia 2-sporous, cheliocystidia, caulocystidia, gloeocystidia) of *Favolaschia calocera*. (Courtesy of Mido Traverso)

also thinks that *Favolaschia* is a genus related to *Tricholomataceae*, near *Physalacria*. With this in mind, we intend to begin a biomolecular investigation to gather additional information in order to solve the problem.

Closely related species, ecology and variations

Favolaschia calocera belongs to the section *Favolaschia* (Singer, 1974) subsection *Auriscalpium* Singer. The section involves species with many acanthocysts, while the subsection has abundant gloeocystidia and brightly pigmented basidiomata. Within this subsection, *F. calocera* differs from the near species owing to its bisporic basidia.

The closest species is considered to be *F. thwaitesii* (Berk. & Br.) Singer, recorded in Asia (Singer, 1974), East Africa (Pegler, 1977) and New Zealand (Stevenson, 1994). The distinguishing characters are summarized in **Table 1**.

Literature provides very little and generic information about the specific substrates where *F. calocera* was observed; only Singer indicates for his var. *claudopus*: dead wood of the dicotyledon *Elaeagnus pungens* Thunb.

Characters	*Favolaschia calocera*	*Favolaschia thwaitesii*
Pores width	1-2 mm (Heim 1945) 1-2 mm (our observations)	0.3-0.4 mm (Singer 1974) 0.18-0.4 mm (Pegler 1977)
Basidia	bisporic, *Dacrymyces* like (Heim 1945; Buyck *et al.* 1998; our observations)	tetrasporic (Singer 1974; Pegler 1977)
Clamp connections	absent (Heim 1945; Buyck *et al.* 1998; our observations)	present (Singer 1974; Pegler 1977)

Table 1. Discriminating features between *F. calocera* and *F. thwaitesii*

The macroscopical and microscopical characters of the various samples we observed match those from literature except for the basidia which, in our case, are longer (62.5 x 10 µm) than those described by Heim (33-36 x 7-10 µm) and Buyck [(30-)35-40(-45)x9-11 µm].

Our measurements are similar to those carried out by Singer on the variety *F. calocera* var. *claudopus*, collected in New Zealand (22-58x5.5-11 µm). This variety differs from the type by the smaller size of the pileus (4-6 mm) and the sub-sessile basidiomata (stipe 1.5 x 0.8 mm). Sometimes, we observed both sessile and long stipitate basidiomata on the same matrix; furthermore, the latter kind of basidiomata becomes more common whenever the matrix is partially covered by fallen leaves or woody debris. For this reason, the above-mentioned variety probably has no taxonomical value, since the main distinctive characters strongly depend on the growing conditions.

Distribution

All the available studies indicate that *F. calocera* has been only collected in Madagascar (Heim, 1945; Buyck *et al.*, 1998) and New Zealand (Singer, 1974; Taylor, 1981). The only species in this genus found outside a tropical area are 1) *F. sachalinensis* Parmasto, (Parmasto, 1974), recorded from Sakhalin (former-USSR) on *Sasa* sp. culms (*Bambuseae*) in *Abies* forests and 2) *F. pegleri* Parmasto (Parmasto, 1999) recorded from Russia, Primorski Terr., on dead culms of *Arundinella hirta* (Thunb.)Tanaka, dry fallen leaves of *Quercus mongolica* Fisch., *Artemisia* sp., *Lespedeza bicolor* Turcz. and remains of a fern.

A controversial issue is how this species has spread into our region. The most likely hypothesis is that since the park is in front of a harbor area, the fungal material was carried on wood pallets or boxes coming from the previously mentioned countries.

Further and more in-depth hypotheses will be possible when additional investigations will be available together with more information concerning the ecology of the species observed in our climate.

Acknowledgements

The authors thank Mido Traverso and Giuseppina Barberis for their contribution.

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MYCODIVERSITY STUDIES IN SELECTED ECOSYSTEMS OF GREECE: I. MACROFUNGI FROM THE SOUTHERNMOST FAGUS FOREST IN THE BALKANS (OXYA MOUNTAIN, CENTRAL GREECE).

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Abstract Greece shows a high degree of diversity, but very limited information exists on the occurrence and distribution of macrofungi. Intensive foraying in the Oxya Mountain (central Greece) revealed a large number of fungal species previously unreported. In this paper, a total of 213 species belonging to 100 genera, recorded in the beech forest of the mountain (which is the southernmost in Balkans) and in the adjacent alpine zone, are presented together with details on their habit, habitat and taxonomic status. Sixty five infraspecific taxa are new records for Greece, while 11 species (*Botryohypochnus isabellinus, Byssoporia terrestris, Crustomyces subabruptus, Dentipellis fragilis, Endoptychum agaricoides, Gloeocystidiellum leucoxanthum, Leucocortinarius bulbiger, Mycenastrum corium, Oxyporus corticola, Physisporinus vitreus* and *Tyromyces chioneus*) represent first records for the respective genera. Two species known up to now from coastal areas (*Xerula xeruloides* and *Geastrum schmidelii*) were recorded in this mountain. In addition, 51 species were recorded for the first time in *Fagus* forests or in alpine areas of Greece and two of them (*Byssoporia terrestris* and *Ceriporiopsis subvermispora*) were recorded for the first time on *Fagus* in Europe. The occurrence of several other species extends to the south their known distribution limits for Europe, while many taxa are typical representatives of the Mediterranean mycoflora.

Key words: biodiversity, Mediterranean region, mushrooms, beech

INTRODUCTION

The beech forests occur on almost all mountains of northern and central Greece. Their vertical distribution begins at elevations of 180 m above sea level (Kentavros Mt. in Thraki) and reaches 1,800-2,000 m (Olympos Mt. in Thessalia). In total, they cover 230,000 hectares which consist of *Fagus sylvatica* L. ssp. *sylvatica* (mainly in the northern and central regions, at 1,200-2,000 m), *F. sylvatica* L. ssp. *orientalis* (Lipsky) Greuter & Burdet (mainly in the eastern regions, at 180-1,200 m) and *F. moesiaca* (K. Maly) Szafer (at all regions and altitudes) (Moulopoulos 1965). The southernmost limit in the *Fagus* distribution in Greece is the beech forest of the

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Oxya Mountain, extending between 38°45′24′′-38°48′24′′N latitude and 21°56′29′′-22°00′15′′E longitude (Fig 1).

The Oxya (or Sarantaina)[1] Mt. lies in the middle of the continental region of Sterea Hellas, in the proximity of other high mountains like Tymphristos, Vardoussia, Kaliakouda and Naupactia Mts., and forms the natural limit between the administrative prefectures of Fthiotida, Eurytania and Aitoloakarnania. The highest peak is at 1,926 m, and its relief presents slight to medium slopes. It belongs to the eastern part of the mountain chain of Pindos-Olonos, which was formed in the Eocene Age (Tertiary Period) of the Coenozoic Era. The rocks are sedimentary, mainly deep flysch, from successive layers of sandstone and clay schist. The soils are characterized as dark, of loamy-sand texture and of shallow to deep profile (A1, B, C1) or as dark, loamed and of general profile (A, B, C). The existing humus layer is mull for the beech forest and moder for the fir forest.

On the eastern part of the mountain and on the sides with east to north-east exposure, a characteristic zonation of different forest types exists (Fig. 2). The beech forest, consisting from mixed *F. sylvatica* and *Fagus moesiaca* trees (Moulopoulos 1965), covers a total area of approximately 922 hectares and occupies the higher zone (1,300-1,800 m a.s.l.), adjacent to the alpine region.

The zone of the fir lies just below (850-1,300 m), and consists almost exclusively of *Abies cephalonica* J.W. Loudon. At lower altitudes, there is a belt of mixed chestnut (*Castanea sativa* Mill.) and deciduous oak (*Quercus pubescens*Willd., *Q. frainetto* Ten. and *Q. petraea* (Mattuschka) Liebl. forests. At the southern side, beech is succeeded by *A. cephalonica* intermixed in certain locations with *Castanea*, *Quercus* and *Pinus* trees. The northern part of the mountain is dominated by fir, which is succeeded by mixed forests of *Castanea sativa* and *Quercus* spp. In addition, other tree species are found scattered within the principal forests already described, e.g. *Acer pseudoplatanus* L., *Platanus orientalis* L., *Prunus pseudoarmeniaca* Herdr. & Sartr., *Carpinus orientalis* Lamk, *Populus* spp., *Cornus* sp., *Salix* spp., *Juniperus* spp. (forming also distinct plant communities in certain positions), *Ostrya carpinifolia* Scop., *Alnus glutinosa* (L.) Gaertn., *Robinia pseudoacacia* L., etc. The beech forest is undergoing systematic logging. The existing forest clearings and the alpine zone are used for sheep and goat grazing from the spring to the autumn.

The climatic conditions of the research area are typical of the larger mountainous region of central Greece. According to data from the closest Meteorological Station located in Agios Nicolaos (7′ latitude to the north, at 1,120 m) the mean annual temperature is about 10°C, while the mean annual absolute minimum and maximum temperatures are 0.7°C and 21.4°C respectively (the coldest month is January and the warmest is July); the mean annual relative humidity is 70-75% (fluctuating between 40% in the summer, and 100% during autumn and winter when long periods of mist and drizzle occur), and the mean annual rainfall is 2,145 mm (December is the most rainy month and July the driest). Specifically, for the beech forest area of Oxya Mt., the temperatures are usually lower and the most rainy month is November, with snowfall beginning towards the end of this period and snow persisting until April-May.

METHODOLOGY

The investigation of the mycoflora of the Oxya Mt. begun over ten years ago, and fragmentary data on the occurrence of macrofungi were included in the Greek macrofungi checklists (Zervakis et al. 1998, Zervakis et al. 1999). During the most recent five-year period (1997-2001), an intensive research was undertaken on the mycodiversity of this particular *Fagus*

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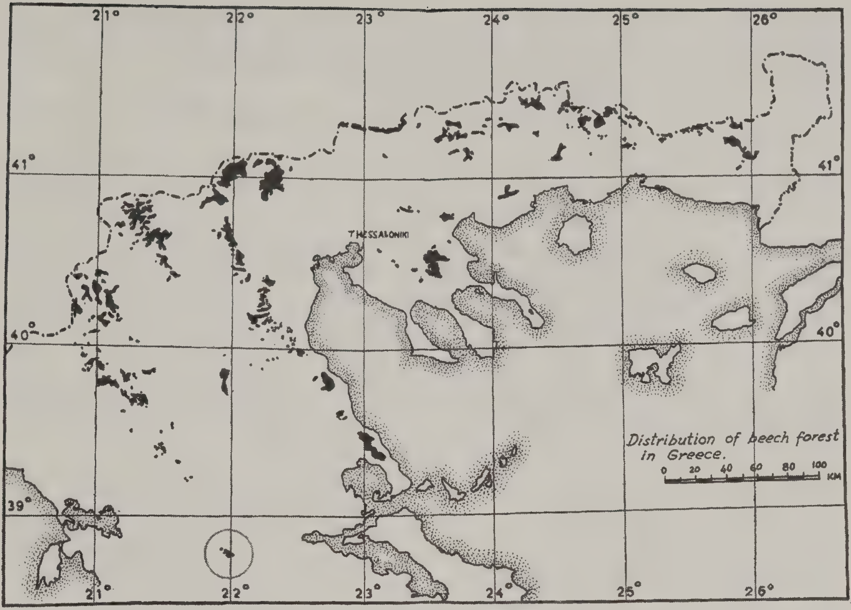
[1] "Oxya" is the Greek name for the beech tree. The name "Sarantaina" originates from the number 40 (saranta in Greek), and it was given to the mountain after forty people present in a wedding procession had been buried by a snowstorm (Fouka-Reze, 1997).


21°
22°
23°
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26°
41°
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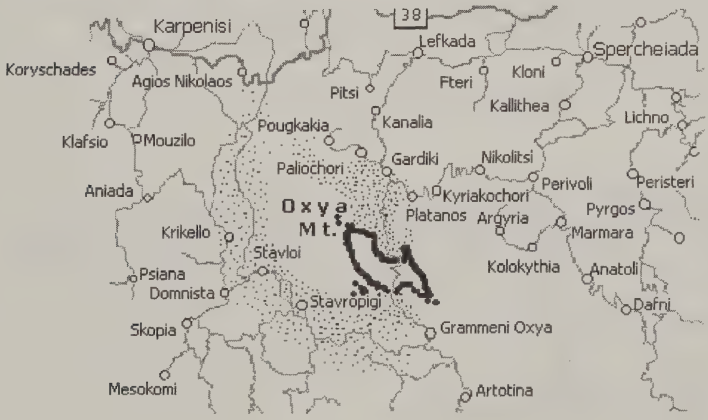
39°
THESSALONIKI
Distribution of beech forest in Greece.
0 20 40 60 80 100 KM

Fig. 1. The distribution of beech forests in Greece. The beech forest of the Oxya Mountain is indicated in the circle (from Moulopoulos 1965, modified).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Karpenisi
Lefkada
Spercheiada
Koryschades
Agios Nikolaos
Pitsi
Fteri
Kloni
Kallithea
Lichno
Klafsio
Mouzilo
Pougkakia
Kanalia
Gardiki
Nikolitsi
Paliochori
Perivoli
Peristeri
Aniada
Oxya Mt.
Kyriakochori
Platanos
Argyria
Pyrgos
Marmara
Krikello
Stavloi
Kolokythia
Anatoli
Psiana
Domnista
Stavropigi
Dafni
Skopia
Grammeni Oxya
Mesokomi
Artotina

Fig. 2. The forests distribution on the Oxya Mountain: the area enclosed by the bold line is occupied by *Fagus*; the dotted area is occupied mainly by *Abies*.

ecosystem. Specimens were collected from March to the beginning of December at intervals of about 15-25 days, except the summer months of July and August when the research area has been forayed 1-2 times only. Foraying and collecting covered almost the entire beech forest and the alpine area; however, three sites were studied in detail:

Site 1 (S1): *Fagus* forest edge and forest meadows with sheepfolds, altitude 1,350-1,450 m (38°47′6′′N, 21°582′1′′E).

Site 2 (S2): *Fagus* forest with NE exposure, altitude 1,550-1,650 m, (38°46′36′′N, 21°58′45′′E).

Site 3 (S3): *Fagus* forest with SE exposure, altitude 1,550-1,600 m, (38°46′15′′N, 21°58′57′′E).

Field parameters and macroscopic characteristics of the collected specimens were recorded *in situ*. Microscopic observations and micro chemical reactions were carried out in the Laboratory of General & Agricultural Microbiology at the Agricultural University of Athens (LGAM-AUA). Additional examinations were performed (where needed) at the National Agricultural Research Foundation, Institute of Kalamata. For the identification, field books, general and specialized keys and monographs were used (e.g. Watling 1973, Dennis 1981, Singer 1986, Moser 1983, Bigelow 1982, 1985, van Waveren 1985, Arora 1986, Ryvarden & Gilbertson 1993, Breitenbach & Kränzlin 1984-2000, Bas et al. 1988, 1990, 1995, Hansen & Knudsen 1992, 1997, Eriksson et al. 1973-1984, Hjortstam et al. 1987, 1988).

The present list contains all the species ever recorded by the authors in this *Fagus* forest. A few taxa of basidiomycetes recorded before the summer of 1996 and of larger ascomycetes recorded before the winter of 1999, which were omitted from the checklists of the Greek mycoflora (Zervakis et al. 1998, Zervakis et al. 1999), were added here. The species recorded in the adjacent to the *Fagus* forest alpine zone are also included in this inventory.

The species are presented in alphabetical order. Nomenclature follows, with some exceptions, the guidelines of the Dictionary of Fungi (Hawksworth et al. 1995). When necessary, comments follow each species citation. Taxa reported for the first time from Greece are marked by an asterisk (*), while new habitat or host/substrate records for Greece are marked by a cross (†). Almost all species cited in this study are deposited in the herbarium of the LGAM-AUA. A photographic archive is also maintained, and pure cultures are available for certain specimens.

The Greek geographical names are those used in the current language (dimotiki) and their transcription into English follows the international standard ISO 843 (1999).

DATA RECORDED

Ascomycotina

Biscogniauxia nummularia (Bull.) Kuntze
Very common on dead branches. This species has not yet been associated with decline of beech trees in Greece; however, reports of losses in *F. sylvatica* forests in Sicily were attributed to *B. nummularia*, which were further related to the stress caused by dry weather conditions (Granata & Whalley 1994).

Bisporella citrina (Batsch) Korf & S.E. Carp.
Very common on dead, barkless branches and cutting surfaces of logs during autumn.

Diatrype disciformis (Hoffm.) Fr.
Common on dead branches, recorded during spring.

****Gyromitra gigas*** (Krombh.) Cooke
Collected in May 2001 (S1) in the proximity of sheepfolds in a forest clearing under very dense herbs vegetation (consisting mainly of *Urtica urens*). This species has been collected for the first time in April 1999 in the *Abies* forest of the Oxya Mt. (Dimou, unpublished data).

Gyromitra infula (Schaeff.) Quél.
Rare, recorded only once in this forest October 1994 (S1) (Zervakis et al. 1999). One previous report from *Pinus sylvestris* and *Fagus orientalis* (Diamandis 1992).

†***Helvella crispa*** Scop.
Rare, recorded for the first time in *Fagus* woods, November 1994 (S2).

Helvella lacunosa Afz.
Common in *Abies* woods but very rare in deciduous forests (Zervakis et al. 1999). Recorded once in this forest, at the end of October 1994 (S3).

†***Hyaloscypha hyalina*** (Pers.) Boud.
The tiny apothecia (0.15-0.3 mm in diameter) of this fungus became discernible during the examination under stereoscope of a piece of wood with cushion-like sporodochia (*Tubercularia* type) (May 2001, S1). *H. leuconica* (Cooke) Nannf. has similar apothecia but occurs on conifers and has shorter ascospores. One previous record on *Populus* sp. (Diamandis 1985).

Hymenoscyphus virgultorum (F.H. Wigg.) W. Phillips
Relatively common on dead fallen twigs during spring. Surprisingly, there are no other reports of this species from Greece (Zervakis et al. 1999).

Hypoxylon fragiforme (Pers.) J. Kickx f.
Very common on dead trunks and branches. In Greece reported only from *Fagus* woods (Zervakis et al. 1999).

†***Morchella elata*** (Fr.) Boud.
This collection made in May 2001 from a forest clearing (S1) presented a total ascocarp height of 6.5 cm with cap length equal to that of the stalk; cap cylindrical, 1.8 cm in diameter, with rounded top, with black, almost parallel longitudinal ribs connected by cross-ribs, alveolae dark olive-brown; stalk cylindrical, 1.2 cm in diameter but base slightly wider, longitudinal wrinkled, granulose, whitish to ochre. This species is known from literature as a conifer inhabitant, but Jacquetant (1984) has also reported it from *Quercus* woods.

Peziza arvernensis Boud.
Relatively common, collected from leaf-litter during the autumn of 1998 and early in the spring of 1999 (Zervakis et al. 1999).

Peziza micropus Pers.
This shortly stipitate *Peziza* with layered trama and smooth to very faintly punctate spores, was collected in September 1999 from a rotting wood-crack on a living trunk (S2). *P. cerea* Bull. has similar microscopic features, but its apothecia are sessile and occur at a different habitat (Svrček 1970).

****Peziza moravecii*** (Svrček) Donadini
This fungus is known as coprophilic. Our collection from residues of fully decomposed wood (October 1999, S2) presented a cup-shaped ascocarp up to 5 cm in diameter, without stipe, but with a distinct mycelium and adhered debris at its base; hymenium hazel-brown, outer surface whitish finely furfuraceous; trama unlayered with projecting curled excipulum hyphae; spores punctate 13.5-17 x 7-9 μm. According to available literature (Svrček 1968, Donadini 1979, Breitenbach & Kränzlin 1984) this collection fits best the descriptions of *P. moravecii*.

Scutellinia scutellata (L.) Lambotte
Recorded for the first time in October 1994 on fallen branches and twigs. Rather rare during spring and autumn in wet places. Only one other report from *Fagus* woods (Zervakis et al. 1999).

Xylaria hypoxylon (L.) Grev.
Common on decomposing wood lying on the ground.

Basidiomycotina

Agaricus arvensis Schaeff.
Recorded in pastures rich in sheep-manure (S1) (Zervakis et al. 1998).

Agaricus bisporus* var. *bisporus (Lange) Imbach
Recorded in May 2001 on the manured soil of a sheepfold in a forest clearing (S1). One previous report of this taxon in several areas in Greece (Callac et al. 2000).

†***Agaricus campestris*** L.
Collected from forest pastures (S1) (Zervakis et al. 1998) and from alpine pastures (October 1998). Common.

****Agaricus macrosporus*** (F.H. Møller & Jul. Schäff.) Pilát
Robust agaric, with pileus diameter up to 16 cm (or up to 20 cm when expanded) and spores size 9-13 (-14) x 6-7 μm. Collected early in October 1998, from alpine pasture (at altitudes of 1,590-1,720 m). *A. excellens* is a very similar species (both macro- and microscopically) but it occurs in forests at lower altitudes.

****Agaricus mediofuscus*** (F.H. Møller) Pilát
Collected in October 1999 from an alpine pasture. Our collection fits the literature descriptions of microscopical features (Cappelli 1984). Macroscopically is somewhat larger (pileus diameter ca. 12.5 cm, and stipe size 11.0 x 2.5 cm) and the pileus is uniformly colored dark violet-brown (the small scales does not contrast sharply to the pileus background). *A. langei* (F.H. Møll.) F.H. Møller which is somewhat larger occurs exclusively in coniferous forests. The pileus appearance and the habitat preference are similar to *A. cupreobrunneus* (Jul. Schäff. & Steer) F.H. Møller (Breitenbach & Kränzlin 1995).

****Agaricus pampeanus*** Speg.
Collected for the first time October 1998. Very similar to *A. campestris*, but its spores are larger (8-11 x 5-7 μm) with a more or less distinct germ pore. Rather common, in meadows around sheepfolds and along roadsides rich in sheep-manure (S1).

†***Agrocybe praecox*** (Pers.) Fayod
Recorded once in June 1999 in the foliage under trees (S1). Only one previous record from fields (Pantidou 1990).

****Amanita franchetii*** (Boud.) Fayod
The yellow-cupped form of *Amanita franchetii* (as our specimen) was formerly classified as *A. aspera* var. *franchetii* Boud. non *A. aspera* Pers.. Collected in September 1999 from the SE side (S3) on the forest edge neighbouring the alpine zone.

Amanita muscaria (L.) Hook.
Common throughout the forest from October to November.

****Amanita submembranacea*** (Bon) Gröger
Solitary, collected once in 1998 (October) and twice in 1999 (September, October), on the forest edge by the alpine zone (altitudes 1580-1680 m; S2, S3). This species differs from the very similar *A. battarae* Boud. by the veil remnants on the pileus, which consist mainly from sphaerocysts. *A. battarae* has a pileipellis with strongly gelatinized superficial layer, it lacks veil remnants on the pileus and the veil at the stipe base (volva) is mainly composed from hyphal tubular elements.

Armillaria gallica Marxmüller & Romagn.
The identification of this fungus, which possesses basidia with clamps, was based on morphological and cultural characteristics (Tsopelas 1999). Common and extremely abundant during the autumn of 1998. In one collection (October 1999) from the cavity of a stump we observed sclerified 1-4 spored basidia (Singer 1986) in increasing frequency from the base to

the edge of the lamellae. Tsopelas (1999) has recorded this species on a variety of hosts in Greece. All the previous records of *Armillaria* species were reported as *A. mellea*.

Armillaria mellea (Vahl) P. Kumm.
This is the only easily (microscopically) identifiable European species thanks to its clampless basidia (Korhonen 1978). Recorded only once in this forest (Zervakis et al. 1998). Many reports from a wide range of hosts and ecosystems, but at least five *Armillaria* species had been accomodated under the name *A. mellea* (Tsopelas 1999).

Bjerkandera adusta (Wild.) P. Karst.
On standing stumps. Quite common recorded during spring and autumn. Several previous records in Greece, mainly on *Fagus*.

Boletus edulis Bull.
Rather rare in the investigated *Fagus* forest, collected twice in October 1998 (at the side of south-eastern exposure).

*****Boletus radicans*** Pers.
This species belongs to the section *Calopodes* and is characterized by the absence of any red tones on the stipe. It was recorded once in October 1999 (S1).

*****Boletus reticulatus*** Schaeff.
We identified our collection as *B. reticulatus* based on the habitat, the pale brown pileus, and the beige stipe covered with a very fine brownish reticulum. Two collections in September 1999 (S2) and July 2001 (S3). Keltemlidis (1990) has reported that this mushroom is collected in some regions of Greece without providing any specific records.

*****Botryohypochnus isabellinus*** (Fr.) J. Erikss.
Recorded in May 2001 on the underside of a fallen decaying trunk and on plant residues of the contacting ground (S1). This species is characterized by the broad clampless short-celled (in right angles branched) hyphae, the short cylindrical basidia and the subglobose, spinose and almost hyaline spores. Recorded for the first time in *Quercus* forests in southwestern Peloponnisos (Zervakis et al. 2002b).

*†****Bovista nigrescens*** Pers.
In wood and alpine pastures, especially near sheepfolds, together with *B. plumbea* from the early autumn.

*†****Bovista plumbea*** Pers.
Rather common in the same locations as the previous record.

*****Byssoporia terrestris*** (DC.) M.J. Larsen & Zak
Collected once early in the spring of 1999 from fully-decomposed wood (S1). Easily identified by its soft, resupinate, poroid, yellow basidioma and the subglobose, thick-walled spores. Rare, although a widespread species in Europe, occurring mainly in coniferous forests. According to the literature (Ryvarden & Gilbertson 1993) this is the first record on *Fagus* wood. First record for Greece of this monotypic genus.

Calocera cornea (Batsch) Fr.
Quite common during the autumn.

*†****Calocybe carnea*** (Bull.) Donk
Collected from an alpine pasture in October 1999. Reported only once before from Greece (Diamandis 1985).

*****Ceriporiopsis subvermispora*** (Pilát) Gilb. & Ryvarden
On dead wood, one collection early in September 1999 (S2).The *Ceriporiopsis* species are resupinate and are distinguished from *Oligoporus* species in causing white rot. Our collection fits to the description of Ryvarden & Gilbertson (1993), and it was distinguished from *C. portcrosensis* (A. David) Ryvarden & Gilb. by its thicker tube layer. In Europe *C.*

subvermispora was previously recorded only on *Picea*, and in North America on other conifers and on *Acer*, *Populus* and *Quercus* (Ryvarden & Gilbertson 1993).

†***Clavariadelphus pistillaris*** (Fr.) Donk
Collected in the leaf-litter in September 1999 (S2). Only one previous record from *Quercus frainetto* (Diamandis & Perlerou 1994).

****Clitocybe catinus*** (Fr.) Quél.
Rare species, collected in October 1998 from the alpine zone. Very similar to *C. gibba*, it differs in having more pale to whitish pileus, broader stipe, a farinaceous odor (instead of the almond-like odor of the latter) and bigger spores.

****Clitocybe gibba*** (Fr.) P. Kumm. **var.** ***gibba***
This *Clitocybe* with an infundibuliform cap, white lamellae and (short) stipe, differs from the normal type in having foxy-colored pileus surface. Collected once in October 1998 (S1) in a forest clearing, among ferns and grasses. According to Bigelow (1985), the pileus color of *C. gibba* is very susceptible to the environmental and climatic conditions, and hence different varieties are distinguished.

Clitocybe nebularis (Batsch) P. Kumm.
Common in all forest types of Greece.

****Clitocybe obsoleta*** (Fr.) Quél.
This species was collected from the foliage of a forest clearing, initially at the end of October 1999 (S1) in a semi-dried condition and had a pileus 2.5 cm in diameter, pale ochre-pinkish, with a faintly striate and deeper-colored margin (indicating hygrophanous state in wet conditions) somewhat incurved, center depressed, characteristic odor (like *C. odora*) and spores 6-9(-10) x 4-5 μm. A second collection in fresh condition during October 2001 from the same place, gave us the opportunity to obtain a white spore-print and distinguish it from *C. deceptiva* Bigelow which gives a pale pinkish buff spore-print (Bigelow 1982). *C. fragrans* (Fr.) P. Kumm. (which is considered as synonym of *C. deceptiva* by Bas et al. 1995) gives also white spore-print but the pileus is watery whitish with dark center (which turns darker when dry).

Clitocybe odora (Bull.) P. Kumm.
Common in hardwood and coniferous forests.

Collybia butyracea (Bull.) P. Kumm.
Common in hardwood and coniferous forests of Greece but in this *Fagus* forest it was recorded only once in October 1998.

†***Coniophora arida*** (Fr.) P. Karst.
Recorded in October 1999 on the cut surface of a dead trunk lying on the ground (S2). Very similar to *C. puteana*, it differs in possessing dextrinoid conidia. Two previous reports, on *Castanea sativa* and *Pinus* spp. wood (Minter 1988), and on *Abies cephalonica* wood (Zervakis et al. 2002a).

****Conocybe pilosella*** (Pers.) Kühner
Recorded once in September 1998, on rotten trunk (S3). This species is characterized by the small spores and the occurrence on wood. Furthermore the hygrophanous striate pileus becomes not striate when dried.

****Conocybe rubiginosa*** Watl.
This species is well characterized by the large (over 16 μm) spores, the 1-2 spored basidia and the presence of lecythiform mixed with capilliform caulocystidia. Our collection had spores elliptical in frontal view and amygdaliform in lateral view, like in *C. ambigua* Kühn.: Watl., but distinctly larger measuring 13-19 x 9-14 x 7-10 μm. Breitenbach & Kränzlin (1995) reported for *C. rubiginosa* spores elliptical in both frontal and lateral view. Collected in May 2001 in the alpine zone.

***Conocybe semiglobata** (Kühner) Kühner & Watl.
Collected once in October 1998 from the alpine zone (altitude 1,700 m). Very similar macroscopically to *C. tenera* but with broader spores and not reacting to NH_3. One more record in *Abies cephalonica* (Zervakis et al. 2002a).

***Conocybe siliginea** (Fr.) Kühner
Collected in October 1999 around a sheepfold, among grasses, at the forest edge (S1). This species looks like *C. rickenii* but it is smaller in size and it has exclusively 2-spored basidia.

†***Coprinus cinereus*** (Schaeff.) Gray
Collected in September 1999 from a dung-heap outside a sheepfold in the alpine zone. Reported once before (Maire & Politis 1940) without any habitat reference.

Coprinus comatus (O.F. Müll.) Gray
Solitary or gregarious, recorded every year during September and October, mainly at the forest roadsides.

Coprinus disseminatus (Pers.) Gray
Collected twice (October 1998 and September 1999). Only two previous records from *Quercus frainetto* (Diamandis 1992) and *Fagus sylvatica* (Zervakis et al. 1998) woods.

Coprinus micaceus (Bull.) Fr.
Not rare, collected in large clusters during September and October from buried wood and from standing decomposed stumps.

†***Coprinus radians*** (Desm.) Fr.
Collected in September 1999 from leaf-litter and wood debris (S3). Relatively rare, recorded only once before on wood construction (Diamandis & Perlerou 1990).

***Coprinus silvaticus** Peck
Gregarious, growing around stumps in September 1996 and 1999 (S3). Easily identified microscopically by its characteristic warted spores. Pantidou (1990) included this species into her field book, but without providing any record information. Hence, this collection must be considered as the first record for Greece.

***Coprinus xanthothrix** Romagn.
It was recorded once, in September 1998, growing solitary on leaf-litter (S2). This member of the section *Coprinus* sect. *Micacei* has a pileal veil composed of thick-walled, tubular to fusoid and catenate cells (like *C. domesticus*) but it produces distinctly broader spores much like *C. radians*. Furthermore both *C. domesticus* and *C. radians* have a more robust appearance.

Cortinarius alboviolaceus (Pers.) Fr.
Rare species, collected once in October 1995 (Zervakis et al. 1998) and this was the first record from *Fagus* forests in Greece. Only one previous record in *Abies cephalonica* (Diamandis & Minter 1983).

Cortinarius amoenolens R. Henry
Collected in November 1996 and late in September 1999 (S2). One previous record in mixed *Fagus-Quercus* forests (Diamandis 1992).

***Cortinarius cinnabarinus** Fr.
This beautiful red species is a broad-leaved forests inhabitant (particularly in *Fagus* forests) and is distinguished from the similar *C. sanguineus* (Wulfen: Fr.) Gray (which occurs in coniferous forests) in possessing a hygrophanous pileus. Rare and collected only once late in October 1998 (S3).

†***Cortinarius pseudosalor*** J.E. Lange
Collected at the end of September 1999 (S2). Only one previous record in *Castanea sativa* woods (Pantidou 1990).

Ganoderma applanatum (Pers.) Pat.
Very common on stumps and living *Fagus* trees (Zervakis et al. 1998). Recorded previously on a variety of (mainly broad-leaved) trees in Greece.

Ganoderma australe (Fr.) Pat.
Recorded on coniferous and broad-leaved trees in Greece (reported previously as *G. adspersum*), but this was the first record from *Fagus* living trees (Zervakis et al. 1998).

†***Ganoderma carnosum*** Pat.
Basidiomata collected in July 1999 and August 2001 from a stump on which *Meripilus giganteus*, *Oxyporus corticola*, *Trametes versicolor* and many other species were collected. This species is very rare on hardwoods (Ryvarden & Gilbertson 1993). Three previous reports in Greece from *Abies* spp. woods (Minter 1988, Diamandis & Perlerou 1990, Zervakis et al. 2002a). *G. carnosum* is distinguished from the hardwood-inhabiting *G. lucidum*, by its blackish brown stipe and upper surface of pileus, and by the broader spores. Moreover, our collections did not form chlamydospores in pure culture, which characterize *G. lucidum*.

†***Ganoderma pfeifferi*** Bres.
Collected in June 2000 on the base of a trunk (S1). Rare species distinguished from *G. resinaceum* Boud.(both species with resinous and melting in the flame of a match pileus surface) by the cracked and wrinkled resinus layer on the pileus, the dark brown context, the broader spores (10-12 x 7-9 μm) and a characteristic sweet odor. Recorded once before in Greece on *Quercus coccifera* (Petrak 1943).

****Geastrum schmidelii*** Vittad.
Although this small-sized *Geastrum* with the short-stalked endoperidium is known from the literature (Pegler et al. 1995, Ellis & Ellis 1990) to occur in coastal areas, it has been collected at the end of October 1998 from the alpine area of this mountain. *G. campestre* Morgan is close but hygroscopic.

****Gloeocystidiellum leucoxanthum*** (Bres.) Boid.
Recorded on the underside of a barkless branch lying on the ground. Our collection possessing spores 12-15 x 5-6 μm fits to the description of the Scandinavian *Salix*-form ("f. *salicis*") (Eriksson & Ryvarden, 1975). First record of the genus for Greece.

Grifola frondosa (Dicks.) Gray
This species was recorded for the first time by the authors in the beech forest of Pilion Mt. (Zervakis et al. 1998). This is the second record for Greece (at the end of October 1998).

†***Handkea utriformis*** (Bull.) Kreisel
Common along forest roadsides, around sheepfolds, in forest and alpine pastures (new habitat record for Greece), collected in the spring but mainly in the autumn. Surprisingly, it has been reported only twice before (Maire & Politis 1940, Diamandis 1992).

†***Hebeloma crustuliniforme*** (Bull.) Quél.
Rare species, recorded once during October 1995. Several previous reports, but all from coniferous forests.

Hebeloma sinapizans (Paulet) Gill.
This species is close to *H. crustuliniforme*, but it differs macroscopically in having slightly darker pileus and non-guttate (spotted when dried) lamellae. However, our collection possesses slightly smaller spores (9-12 X 5.5-7 μm), 2-spored basidia are present, while cheilocystidia with ventricose base are lacking (Breitenbach & Kränzlin 2000). Collected in September 1999 (S3). One previous record in *Fagus* forest (Maire & Politis 1940).

Hericium coralloides (Scop.) Pers.
Collected from a fallen branch in September 1999 (S3). The similar-looking *H. alpestre* Pers. occurs on conifers and has larger spores. Only one record in the past from the same host (Diamandis 1983).

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Hericium coralloides (Scop.) Pers.
Collected from a fallen branch in September 1999 (S3). The similar-looking *H. alpestre* Pers. occurs on conifers and has larger spores. Only one record in the past from the same host (Diamandis 1983).

Hericium erinaceus (Bull.) Pers.
Rare species in the investigated forest, recorded in October 1992 (Zervakis et al. 1998), in a big cavity of a trunk lying on the ground. Recently (October 2001), it was recorded on a wounded living tree. This trunk-cavity inhabiting species is probably under threat because of the intensive logging (Diamandis 1992).

Hydnum repandum L.
Common in coniferous and hardwood forests, but recorded only once (October 1994) in this forest (Zervakis et al. 1998).

†***Hygrophorus cossus*** (Sowerby) Fr.
Collected in October 1998 (S3); previously reported only from *Quercus* forests in Greece.

Hygrophorus eburneus (Bull.) Fr.
A rather common species in deciduous forests of Greece (Zervakis et al. 1998). In the investigated beech forest it was collected during October 1998 and 1999.

Hymenochaete rubiginosa (Dicks.) Lév.
Several records in Greece, on *Castanea*, *Quercus* and *Fagus*. Rare in the investigated beech forest recorded only once on rotten wood (Zervakis et al. 1998).

†***Hyphoderma praetermissum*** (P. Karst.) J. Erikss. & Strid
Collected in October 1999 from a barkless rotting trunk (S2) in a dried condition. This specimen had a fissured, yellow-ocherish color surface and was characterized by three different types of cystidia: a) few projecting leptocystidia slightly capitate (not encrusted) 60-70 x 7-8 μm, b) abundant enclosed in the subhymenium gloeocystidia up to 150 x 10-12 μm, and c) pyriform stephanocysts abnormally distributed and enclosed in the subhymenium. One previous record on *Abies* sp. (Minter 1988).

****Hyphodontia aspera*** (Fr.) J. Erikss.
It was collected early in the spring (April 1999) just after the snow melting, from a fallen and decomposed branch (S1). It is very similar to *H. breviseta* (P. Karst.) J. Erikss., but it has more distant spines and slightly larger spores.

****Hyphodontia barba-jovis*** (Fr.) J. Erikss.
Collected in October 1999 from a rotting trunk (S2). This species is easily recognized from the densely arranged spines with the brush-like tips and the long, cylindrical, thick-walled (except the apex) skeletal, hypha-like cystidia. The specimen was infected by a mitosporic fungus whose conidiophores (*Sporothrix* type) arose among the cystidia in the aculeal apices. A similar observation was made by Eriksson for *Hyphodontia breviseta* (P. Karst.) J. Erikss..

Hypholoma fasciculare (Huds.) P. Kumm.
One of the most common mushrooms in the forest, appearing in clusters growing on leaf-litter and on wood debris. Very common in the broad-leaved and coniferous forests of Greece.

Hypholoma sublateritium (Fr.) Quél.
Less common and abundant than the previous.

Hypsizygus tessulatus (Bull.) Singer
Collected from a living trunk late in October 1998 (S3). A previous collection, (October 1994) was erroneously reported as *Lentinus lepideus* (Zervakis et al. 1998). Recorded only once before, also on *Fagus* (Diamandis & Perlerou 1990).

Inocybe geophylla* var. *lilacina (Peck) Gill.
Quite common in coniferous and deciduous forests but rare in the investigated beech forest, recorded once during autumn 1995 (Zervakis et al. 1998).

****Inonotus nodulosus*** (Fr.) Pilát
Collected from a stump and from fallen branches in October 1998 and 1999 (S2, S3). Similar to *I. radiatus* (Fr.) P. Karst., but the latter has bent hook-like setae and occurs mainly on *Alnus*, while the species reported here has straight setae and grows almost exclusively on *Fagus*.

Laccaria amethystina Cooke
Rare in this forest, recorded twice in 1998 (S2, S3). Common elsewhere in Greece (Zervakis et al. 1998).

Laccaria laccata (Scop.) Berk. & Broome
More frequent than the preceding in this forest but very common throughout Greece in a variety of habitats.

****Laccaria laccata*** (Scop.) Berk. & Br. **var. *pallidifolia*** (Peck) Peck
A number of infraspecific taxa exist within this very variable species (Müller & Vellinga 1986). Specimens with subglobose-globose spores and short stipe (like our collection) should be classified as *L. laccata* var. *pallidifolia* (*L. laccata* var. *moelleri* has rounded spores and a very long stipe). Although this finding (September 1999, S2) constitutes a new record for Greece, it has been probably overlooked before and it was placed among the several records of *Laccaria laccata*.

Lacrymaria lacrymabunda (Bull.) Pat.
Collected in October 1999 growing on leaf-litter (S2). One previous record in *Fagus* forest (Diamandis`1992).

Laetiporus sulfureus (Bull.) Murr.
This was the first record on beech for Greece, on a tree several meters above the ground. Rare in the investigated beech forest collected once in October 1995 (Zervakis et al. 1998), but reported from a variety of hosts throughout the country.

Lactarius blennius (Fr.) Fr.
Collected once, late in October 1998 (S2). A rare species in the area under study. This mycorrhizal species is known to be closely associated with beech trees. All reports in Greece were from *Fagus* forests (Zervakis et al. 1998), except one of Diamandis & Perlerou (1994) in *Quercus frainetto* which is rather ambiguous, and another of Athanasiou & Theochari (1999) from *Pinus nigra* which is definitely wrong.

Lactarius circellatus Fr.
Recorded only once in October 1995 and that was the first record for beech forests in Greece (Zervakis et al. 1998). Few previous reports from *Quercus* forests in Greece.

Lactarius deliciosus (L.) Gray
A common species in other habitats, but rare in this forest, recorded only once in the past (Zervakis et al. 1998).

Lactarius piperatus (L.) Gray
Collected solitary in July 2001 (S3). It is differentiated from the other white, bald-capped *Lactarius* by the very thin and crowded lamellae and by the very sharp-tasting, white milk, non changing on drying or in KOH. Some previous reports from *Quercus* and *Fagus* forests.

Lactarius vellereus (Fr.) Fr.
Rare, collected in September 1999 (S2). Only two previous records in *Fagus* forests (Diapoulis 1939, Diamandis 1992).

Lentinellus flabelliformis (Bolt.) P.D. Orton
Collected in September 1999 from a rotting trunk. Probably common, but only two previous records in Greece, on beech (Pantidou & Gonou 1984) and on *Abies cephalonica* (Zervakis et al. 2002a)

Lepiota alba (Bres.) Sacc.
Rare, collected once in October 1998 from the alpine zone. Macroscopically it is very similar to *L. erminea* (Fr.: Fr.) Gill., which however possesses longer spores. Microscopically it is very similar to *L. clypeolaria* and *L. oreadiformis* Velen., but it differs macroscopically from the former (which grows in forests) in not having a squamulose pileus and from the latter in presenting an obtuse umbo.

†***Lepiota castanea*** Quél.
Recorded in the alpine zone at the end of September 1998. Only one previous record from *Cupressus* woods (Diamandis 1983).

†***Lepiota clypeolaria*** (Bull.) P. Kumm.
Rather common, collected in the forest and in the alpine zone (new habitat record). Several reports from coniferous forests, but only once before from *Fagus* forests (Diamandis 1992).

Lepiota cristata (Bolt.) P. Kumm.
Recorded in October 1998 (S2). Reported previously from conifer and deciduous woods, but only once from *Fagus* forests (Diamandis 1992).

†***Lepiota ventriosospora*** D.A. Reid
This species is macroscopically identical to *L. clypeolaria*, but it is clearly differentiated microscopically by its strikingly long and narrow spores. It has been collected in September 1998 (S2). Reported only once from coniferous forests (Athanasiou & Theochari 1999).

Lepista flaccida (Sowerby) Pat.
Some authors (e.g. Gulden in Hansen & Knudsen 1992, Breitenbach & Kränzlin 1991) consider the flaccid, funnel-shaped form occurring in broad-leaved forests as a synonym of *Lepista inversa* (Scop.:Fr.) Pat. which occurs in coniferous forests. Recorded in groups (S1) (Zervakis et al. 1998). One previous report in *Fagus* forests (Diamandis 1992).

Lepista nuda (Bull.) Cooke
A common species in coniferous but rare in broad-leaved forests and only once recorded in the investigated *Fagus* forest in October 1995 (Zervakis et al. 1998).

****Leucocortinarius bulbiger*** (Alb. & Schwein.) Singer
Recorded in September 1999 (S2), growing gregariously in the foliage of the forest floor. The macroscopic appearance of this fungus is reminiscent of *Cortinarius* taxa of the subgenus *Phlegmacium*, but the hyaline elliptical spores (white spore print) could suggest a *Tricholoma* member (which however lacks clamps). First record of this monotypic genus for Greece.

Lycoperdon echinatum Pers.
Common, usually occurring early in the autumn. In Greece, it was recorded exclusively in beech forests.

Lycoperdon foetidum Bonord.
Rare in this forest, collected once on leaf-litter early in October 1999 (S3). Reported from coniferous and broad-leaved trees in Greece.

Lycoperdon perlatum Pers.
Common during autumn in this forest. Very common throughout Greece, in hardwood and coniferous forests.

Lycoperdon pyriforme Schaeff.
Common on decomposed wood. Common throughout Greece on wood of broad-leaved and coniferous trees.

†***Lyophyllum connatum*** (Schum.) Singer
One collection in November 1998 (S2). Only one previous record in *Pinus sylvestris* woods (Diamandis & Perlerou 1990).

†***Macrolepiota excoriata*** (Schaeff.) Wasser
Recorded in September 1999 (S1) at the edge of the forest, on soil rich in sheep manure near sheepfolds, growing in close proximity with *Endoptychum agaricoides*. Recorded previously only in coniferous forests and once in an olive grove and in a vineyard (Zervakis et al. 1998).

†***Macrolepiota mastoidea*** (Fr.) Singer
Recorded in the forest (S1) as well as in the alpine zone (new habitat record). Only one previous report from *Fagus* forests (Diamandis 1992).

Macrolepiota procera (Scop.) Sing.
Very common, in different forest types. It was found growing during autumn on leaf-litter below trees, in forest meadows, around sheepfolds and in alpine pastures of this mountain (Zervakis et al. 1998).

Macrolepiota rhacodes (Vitt.) Singer **var.** ***hortensis*** (Pilát) Wasser
Very rare in this forest, recorded only once during the last decade (October 1994) in a forest clearing (S1). Elsewhere rather common (Zervakis et al. 1998).

Marasmius alliaceus (Jacq.) Fr.
One of the most common species in this beech forest, appearing during the entire autumn period (Zervakis et al. 1998).

†***Marasmius wynnei*** Berk. & Broome
Gregarious, on leaf-litter, appearing every year during October (S1, S2). It was previously recorded only once in *Pinus halepensis* woods (Maire & Politis 1940).

†***Melanoleuca brevipes*** (Bull.) Pat.
The taxonomy in the genus *Melanoleuca* presents difficulties and the nomenclature is sometimes confusing, but the identification of this species, based on macroscopic and microscopic features (Bon 1991) is rather easy. Although it is known as a common species in Europe, it has only recently been recorded in Greece in conifers (Gonou-Zagou & Delivorias 2000), and in mixed *Abies cephalonica-Quercus coccifera* (Mt. Taygetos) (Zervakis et al. 2002a). Collected in October 2000 in the foliage at the limits of the forest (S1).

****Melanoleuca evenosa*** (Sacc.) Konrad
Bresinsky & Stangl (1977) considered *M. evenosa* as a synonym of *M. subalpina* (Britz.) Bresinsky & Stangl, but Bon (1991) distinguished the latter as having a particularly aromatic odor. Moreover, Bon referred to a broader pileus, stipe shorter than the pileus diameter, longer spores and much broader cystidia [15-25(–30) μm]. Breitenbach & Kränzlin (1991) adopted also this synonymy but they reported stipe shorter than the pileus diameter and slender (11-15 μm) cystidia. Our collection, made in October 1999 from a forest clearing (S1), fits macroscopically and microscopically to Bon's description for *M. evenosa* (pileus 6.2-8.2 cm, stipe 5-6.5 x 0.8-1.1 cm, spores somewhat broader 8-10.5 x 5.5-6.0 μm, cystidia fusiform-sublageniform 50-65 x 12-15 μm).

****Melanoleuca humilis*** (Pers.) Pat. sensu Singer **var.** ***blanda*** Berk.
In October 1999 and in May 2001 two collections have been made on the forest edge, on soil rich in sheep dung and covered with foliage and herbs (S1). These collections were microscopically identical: cheilocystidia long (40-70 x 6-8 μm) awl-shaped to fusiform and monoseptate (*Excissinae* type), apically incrusted, spores faintly to well verrucose, 7.5-9.5 x 5-6.5 μm. In the first collection, the pileus was 7.5-10 cm in diameter, convex to plane, hygrophanous, pruinose to glabrous and shiny to mat, cream to light beige with paler or darker areas, margin involute, undulating and somewhat grooved; stipe was shorter than the pileus diameter (5.0-6.0 x 1-1.5 cm), whitish with fine white flocci. The second collection was in a very mature state with pileus 7-14 cm in diameter, plane, slightly umbonate, undulating, with margin exceeding the lamellae; stipe very short (2-5 x 1-2 cm) tapering to the base, fibrillose, fragile, beige-grey (collected in a short distance from *M. pseudoevenosa*, which however possessed smooth stipe, equal or longer than the pileus diameter).

****Melanoleuca iris*** Kühner
This collection had a pileus 4-8 cm in diameter, grey-brown in the center paling to beige and then to whitish towards the margin. Lamellae whitish to cream, subdecurrent, sometimes forked. Stipe whitish, 4-5 x 0.6-1.3 cm. Cheilo- and pleurocystidia sparse, usually monoseptate, subulate to sublageniform, 55-65 x 6-8.5 μm. Collected at the end of October 1999 in a forest clearing among herbs but close to the trees (S1).

****Melanoleuca pseudoevenosa*** Bon ex Moreno & Bon
Bon (1991) has reported that this species occurs in plains and areas of low altitudes and suggested *M. favrei* Bon as a possible mountainous form. However, the latter has much smaller basidiomata and short (up to 55 μm) cystidia (in our specimens: 50-70 x 7-9 μm, 1-3 septate). *M. substrictipes* Kühner which is mountainous (Kühner 1978) and somewhat similar macroscopically to *M. pseudoevenosa* has also shorter cystidia (up to 45 μm). Our collection (made in May 2001 among herbs, on soil rich in sheep dung and on the limit of forest, S1) differs from Bon's description of *M. pseudoevenosa* only in having broader stipe (up to 1.6 cm).

****Melanoleuca subbrevipes*** Métrod ex Bon
This collection has stinging-hairlike to sublageniform and monoseptate (some apically incrusted with thin crystals) cheilocystidia. The habitus of this collection (at maturity pileus infundibuliform up to 15 cm, and stipe relatively short, up to 5 x 1.5 cm) was the decisive criterium for distinguishing this taxon from the other members of the subsection *Grammopodinae* (Bon 1991). The pileus and stipe color was whitish-ivory with a tint of gray. Collected from a forest meadow in October 1998 (S1).

†***Meripilus giganteus*** (Pers.) P. Karst.
It appears every year, usually early in the autumn, on the base of some old stumps (S1, S2). Two previous reports (Maire & Politis 1940, Diamandis 1992).

Merulius tremellosus Fr.
Collected in September and October 1999 from decomposing stumps (S2, S3). Only two previous records on *Castanea sativa* (Diamandis 1985) and *Fagus sylvatica* (Diamandis & Perlerou 1990) but probably not rare.

Mycena arcangeliana Bres.
Recorded in October 1988, in clusters growing on rotten stumps (S2). Reported twice before (as *M. oortiana* Kühner ex Hora) from *Fagus* forests as well (Diamandis 1983, Avtzis & Diamandis 1988).

†***Mycena capillaris*** (Schum.) P. Kumm.
This white, very small-capped *Mycena* with very long and delicate stipe was collected from decaying leaves in November 2000 (S3). The similar *M. polyadelpha* prefers oak foliage. One previous record (Maire & Politis 1940). Probably not rare but overlooked because of its very small size.

Mycena crocata (Schrad.) P. Kumm.
Quite common in this forest during autumn. Only two previous reports, both from beech forests (Diamandis 1985, Avtzis & Diamandis 1988).

†***Mycena flavescens*** Velen.
Collected in October 1999 from the leaf-litter (S1). Reported only once before from evergreen broad-leaved forest (Diamandis 1985).

Mycena galericulata (Scop.) Gray
Recorded at the end of October 1998 in clusters on foliage and wood debris (S3), and early in September 1999 solitary on a stump (S2). Both collections had (2)-4 spored clamped basidia and ovoid spores (7-10.5 x 5-8.5 μm). Common on hardwoods and conifers (Zervakis et al. 1998).

†***Mycena haematopus*** (Pers.) P. Kumm.
This species has been reported only once (Avtzis & Diamandis 1988, from *Fagus orientalis* forest) before the records in the Oxya Mt. forest, where it appears in October growing gregariously on wood.

†***Mycena inclinata*** (Fr.) Quél.
In the literature this species is mainly associated with *Quercus* (Breitenbach & Kränzlin 1991, Hansen & Knudsen 1992) but we have recorded it in the past (Zervakis et al. 1998) and recently again (September 1999) on beech wood (S1). Reported only once before from *Quercus frainetto* (Diamandis 1983).

****Mycena niveipes*** Murrill
On dead stumps, collected in October 1998 (S3). Similar macroscopically to *M. galericulata*, it is distinguished microscopically in having clavate to fusiform instead of diverticulate cheilocystidia.

†***Mycena polygramma*** (Bull.) Gray
Collected at the end of October 1999 from the leaf litter (S1). Three previous records in *Quercus* spp. and *Castanea sativa* wood.

Mycena pura (Pers.) P. Kumm.
Common during September-October in this forest, and in broad-leaved and coniferous woods throughout Greece (Zervakis et al. 1998).

Mycena rosea (Bull.) Gramberg
Common from September to November, but not abundant in the forests of Oxya Mt. Two previous reports from *Quercus* and *Fagus* forests (Diamandis & Perlerou 1990, Diamandis 1992).

****Mycena stylobates*** (Pers.) P. Kumm.
Collected in October 2000 (S1) growing on fallen leaves. Easily recognizable species from the disc through which the stipe is attached to the substrate, the abnormally cylindrical to diverticulate cystidia and the pileipellis with the brush-like outgrowths of the uppermost hyphae and the sparse thorn-like elements.

****Mycenastrum corium*** (Guers.) Desv.
The coriaceous to corky (when mature), stellately dehiscing endoperidium and the thick-walled, spiny capillitial threads characterize this monotypic genus (Homrich & Wright 1973). Recorded at the end of October 1999 in the same alpine sheepfold (altitude 1,650 m) with *Endoptychum agaricoides*. First record of the genus for Greece.

****Oligoporus hibernicus*** (Berk. & Broome) Gilb. & Ryvarden
Collected in October 2001 (S1) from the rotting interior of a trunk hollow, forming resupinate to slightly effused, whitish to pale cream, basidiomata. Pore surface white to cream, pores round to angular, 2-4 per mm; hyphal system monomitic, hyphae thin- to thick-walled, septa with clamps; spores few, allantoid 5-6 x 1-1.5 μm; cystidia rare, hyphoid (apical crystals not observed). This species is known as a coniferous wood decomposer, while the very close *O. simani* (Pilát) Bernicchia colonizes primarily hardwoods (Ryvarden & Gilbertson 1994). The latter possesses thinner pores (5-7 per mm), more abundant and conspicuous, apical encrusted cystidia and somewhat smaller spores. However it is possible that these two taxa are forms of a single species (Ryvarden & Gilbertson 1994).

****Oligoporus subcaesius*** (David) Ryvarden & Gilb.
This species is similar macroscopically to *O. caesius* which shows a preference for *Abies* and has broader spores. Collected early in spring of 1999 (S1).

Oligoporus tephroleucus (Fr.) Gilb. & Ryvarden
Similar to *Oligoporus stipticus* which prefers conifers and has broader spores. Recorded once in October 1999 (S2).

Oudemansiella ephippium (Fr.) M.M. Moser
Recorded in September 1999 on a rotten stump (S2). Pileus 10 cm in diameter broadly campanulate to plane, shallowly furrowed, radially fibrillose, beige to pale brown, viscid, margin somewhat reticulate; lamellae broad, distant, white with a very pale pink tint and brown edges, intervenose; stipe cylindrical, widening toward the base, 9 x 0.6-0.8 cm, not rooting, white at the apex and increasingly gray to pale brown toward the base; spores ellipsoid (11) 14-16(-17) x (9)10-11 μm; cheilocystidia clavate-cylindrical 45-70 x 17-25 μm, pleurocystidia cylindrical-subutriform with rounded apex and tapering base, 100-120 x 20-35 μm; pileipellis composed from pear-shaped to clavate cells; caulocystidia at the stipe apex clavate (some subcapitate). This ringless species is perhaps overlooked because it shares the same substrate with the very common (but ringed) *O. mucida*.

Oudemansiella mucida (Schrad.) Höhn.
On living deciduous trees but also on dead fallen logs (Zervakis et al. 1998). It presents two forms: a pure white (mainly on living trees) and one with a gray-brown pileus (mainly on dead wood). In the first half of October 1998, it appeared in amazing abundance in the beech forest under study. In Greece, all the records are from *Fagus* forests, except of the report from *Pinus nigra* by Athanasiou & Theochari (1999) which is obviously a misidentification.

Oxyporus corticola (Fr.) Ryvarden
It was collected from stumps during autumn 1998 (S1) and 1999 (S2). *O. latemarginatus* is very similar macroscopically, but it has wider hyphae, rarely capitately encrusted cystidia and no gloeocystidia (present in *O. corticola*). First record of the genus for Greece.

† ***Panaeolus rickenii*** Hora
Collected in October 1998 from grassy sites manured with mule-dung, where mules were used for pulling logs (S1). Hansen & Knudsen (1992) consider it as synonym of *P. acuminatus* (Schaeff.) Quél. which is characterized by a conical-pointed cap, while Breitenbach & Kränzlin (1995) consider both as synonyms of *P. caliginosus* Jungh. since they do not present microscopic differences. Two previous records in Greece (Diamandis 1983, Zervakis et al. 1998).

Panellus stypticus (Bull.) P. Karst.
Common on different host species elsewhere in Greece (Zervakis et al. 1998), but quite rare in the forest under study, recorded only once in September 1999 (S2).

Peniophora incarnata (Pers.) P. Karst.
One collection in September 1999 on a dead barkless log (S2). A few reports from different hardwood species in Greece.

Phallus impudicus L.
Recorded once in September 1999, in only one location (S3), in groups on leaf litter. Relatively rare in Greece (Zervakis et al. 1998).

†***Phanerochaete sordida*** (P. Karst.) J. Erikss.& Ryvarden
This species is easily recognized microscopically from the characteristic (at right angles) branching of hyphae. On fallen dead branches (July 1999, S3). Previously reported only once on *Castanea sativa* (Minter 1988).

****Phanerochaete tuberculata*** (Karst.) Parmasto
This species is characterized by the absence of cystidia. Collected together with *Peniophora incarnata* from the same log.

***Phlebia livida** (Fr.) Bres.
This collection (April 1999, S1) from decomposing wood had an ochre-gray to beige basidioma, with a verrucose-tuberculate surface (under the stereoscope, tubercles apex white), subulate (awl-shaped) cystidia, spores 4.5-6 x 2-2.5 μm and hyphae coarsely covered with crystals.

Phlebia rufa (Fr.) M.P. Christ.
Collected in October 1999 from a dead barkless trunk (S1) in dried state. Two previous records on *Castanea* sp. (Maire & Politis 1940 as *Merulius rufus* Fr.) and on *Fagus* sp. (Diamandis 1992).

†*Pholiota alnicola* (Fr.) Sing.
The absence of cystidia and the presence of clamps on the hyphae characterize this species. Collected in October 1999 from dead logs (S2). Only one previous record without host reference (Diamandis 1985).

Pholiota cerifera (P. Karst.) P. Karst.
Common during autumn, recorded on living trees (often quite high above the ground), on stumps and fallen trunks (Zervakis et al. 1998).

†*Pholiota highlandensis* (Peck) A. H. Sm. & Hes.
One collection in October 1998, among herbs in a forest clearing (S1). A small *Pholiota* with viscid, almost bald, ochre-reddish pileus and abundant cheilo- and pleurocystidia (very few of them with yellow contents). This mushroom is typical of burned soils and was collected from a place where people visiting the forest used to prepare barbecues. One previous report as *Gymnopilus carbonarius* (Fr.) Murr. (Maire & Politis 1940), but it was also found by the authors in burned sites in Naxos Isl. (Polemis et al. 2001) and in conifers in Taygetos Mt. (Zervakis et al. 2002a).

***Pholiota tuberculosa** (Schaeff.) P. Kumm.
One collection from a dead log, early in September 1999 (S2). Very similar to *Pholiota curvipes* (Fr.) Quél., which is considered as a synonym by certain authors (Tjallingii-Beukers 1987, Breitenbach & Kränzlin 1995). Our collection, with cheilocystidia definitely capitate, fits exactly to Moser's (1983) description. Pantidou (1973, 1980) has reported *P. curvipes* on *Abies cephalonica*.

***Physisporinus vitreus** (Pers.) Donk
On the ground (leaf-litter, humus and soil). The very similar *P. sanguinolentus* (Alb. & Schwein.: Fr.) Pilát turns reddish when handled. One collection in October 1999 (S2). First record of the genus for Greece.

***Pleurotus dryinus** (Pers.) P. Kumm.
Collected in October 1998 from a decomposed standing stump, and in September 1999 (Dimou et al. 2001) from a cut but still living trunk (S2). Recently this species was also recorded growing on *Platanus orientalis* (Delivorias & Gonou-Zagou 2001).

Pleurotus ostreatus (Jacq.) P. Kumm.
Common, being collected every year during autumn and early winter. Very common in Greece on a variety of broad-leaved trees and on *Abies*.

Pleurotus pulmonarius (Fr.) Quél.
Very common throughout the autumn period. The first record of this species for Greece was made in the investigated beech forest (Zervakis & Balis 1996).

†*Pluteus nanus* (Pers.) P. Kumm.
Collected once at the end of October 1999 (S1) from the soil humus. Our collection had an appearance resembling *P. diettrichii* Bres., but it possessed pleurocystidia (ventricose, up to 105 x 43 μm) and subglobose, although somewhat bigger spores, 7-9 (-9.5) x 5.5-7 (-8) μm. Rare species recorded only once in the past, in a *Fagus* forest too (Maire & Politis 1940).

Pluteus petasatus (Fr.) Gill.
Recorded in June 2000, July 2001 and October 2001 on rotten stumps (S1). Pileus convex to plane, finally radially fibrillose with squamulose center. Pleurocystidia fusiform, thick-walled, horned. Clamp-connections absent.

Pluteus salicinus (Pers.) P. Kumm.
Recorded in September 1999 on a rotten stump (S2). This species with the slightly umbonate, finally radially fibrillose, light gray-beige pileus (center gray-brown) has thick-walled, horned, fusiform pleurocystidia (like the previous record) but we have also observed some abnormal ones. However, it is clearly distinguished microscopically from *P. petasatus* (which occurs in the same habitat) by the presence of clamp-connections.

Polyporus arcularius Batsch
Common, recorded during spring and autumn on fallen dead branches.

Polyporus badius (Pers.) Schwein.
P. badius is the only polypore with a black stipe and clampless septa. All our clampless *Polyporus* collections had infundibuliform pilei with undulating margin, color deep chestnut to black brown, diameter up to 10 cm, and a central stipe. Recorded during November 1998, September and October 1999 on dead trunks and fallen branches (S2). Quite rare.

Polyporus melanopus Fr.
This collection had a radially fibrillose pileus with slightly involute to undulating margin, color leather-brown to ocherish, diameter up to 5 cm, and a long, eccentric stipe black in the lower half. Septa with clamps and spore length 7-9 μm. This is the most rare among the polypores found in the forest. Recorded in September 1999 on rotting stumps (S2).

Polyporus varius Pers.
Pilei of similar color and texture to *P. melanopus*, but slightly smaller, convex with involute margin. Stipe eccentric, short, black at its base. Septa with clamps and spore length 9-11 μm. Recorded during autumn on rotting stumps and branches. Relatively common.

Psathyrella candolleana (Fr.) Maire
In this forest it appears in the leaf-litter early in the autumn. Easily differentiated microscopically from the macroscopically similar *P. spadiceogrisea* (Schäff.: Fr.) Maire in lacking pleurocystidia.

†***Psathyrella conopilus*** (Fr.) A.Pearson & Dennis
Collected in October 1999 around a sheepfold on a mixture of sheep manure and plant debris, and in October 2000 from a forest clearing (S1). According to Moser's key (1983) *P. conopilus* has a not hygrophanous, not transparently striate pileus (as our first collection), whereas *P. subatrata* (Batsch.) Gill. has a hygrophanous and 1/3 striate pileus (as our second collection). According to Hansen & Knudsen (1992) and Breitenbach & Kränzlin (1995) they are synonyms. Both our collections were microscopically identical and had slightly broader spores [13-18 x 7-9 (-10.5) μm] in respect to the literature. Two previous reports in Greece, from conifers (Maire & Politis 1940, as *P. subatrata*) and broad-leaved woods (Diamandis 1985)

Psathyrella murcida (Fr.) Kits van Wav.
Recorded solitary to grouped in leaf-litter in October 1998 (S1) and in September 1999 (S2). The two other similar-looking (in *Fagus* occurring *Psathyrella* species) *P. fusca* (Schum.) Pears. and *P. phegophila* Romagn. have smaller spores and different pleurocystidia (utriform instead of fusiform-lageniform) (van Waveren 1985).

Psathyrella pannucioides (J.E. Lange) M.M. Moser
Recorded early in October 1999, subcaespitose, growing on the humus within a trunk cavity (S2). The macroscopic and microscopic characters fit to the descriptions of van Waveren (1985) and Hansen & Knudsen (1992), but we have also observed 2- (scarcely 3-) lobed cheilo- and pleurocystidia and 2-spored basidia.

†***Psathyrella tephrophylla*** (Romagn.) Bon
Collected solitary in May 2001 from the beech foliage (S2). This collection possessed a broadly conical, hygrophanous, striate, ochre-brown pileus (centre darker, margin lighter), 6.5 cm in diameter, lamellae gray-violet to gray-brown with whitish edges, abundant utriform pleurocystidia measuring 50-60 X 12-19 μm, and spores red-brown 9-11.5 (-12.7) x 5.5-6.5 (6.7) μm. Only one previous record without habitat reference (Minter 1988).

Pseudoclitocybe cyathiformis (Bull.) Singer
Recorded only in one site (S1) almost every year in September-October, on the ground and on dead logs, near the forest edge. Many previous reports, mainly from conifers.

Ramaria aurea (Schaeff.) Quél.
Recorded often in conifers, but rarely in *Fagus* (Maire & Politis 1940). In this forest recorded once in October 1995 (Zervakis et al. 1998).

Ramaria flava (Schaeff.) Quél.
Distinguished microscopically from the previous in possessing warts in distinct longitudinal rows on the spore walls. Rare in *Fagus*, recorded once in the investigated forest in October 1995 and once again in the *Fagus* forest of Pilion Mt. in November 1995 (Zervakis et al. 1998).

†***Ramaria flavescens*** (Schaeff.) R.H. Petersen
Recorded at the end of October 1998 (S2). It is distinguished from the other yellow *Ramaria* species in possessing clamped septa. One previous record in mixed forest of *Abies cephalonica* and *Pinus nigra* (Delivorias & Gonou-Zagou 2000).

Russula cyanoxantha (Schaeff.) Fr. f. ***cyanoxantha***
Collected in July 2001 (S2, S3) after a summer rainfall together with the next finding. This collection had a pileus basically green mixed in different proportions with purple, lilac and ochraceous colours, white stipe and white spore-print. Several previous reports (aggregated under the name *R. cyanoxantha*) mainly from *Fagus* woods.

*****Russula cyanoxantha*** (Schaeff.) Fr. f. ***peltereaui*** Singer
This collection differed from the preceding in having uniformly green cap. Not as abundant as that one.

Russula delica Fr.
This common mushroom in coniferous habitats is very rare in broad-leaved forests (only one previous record by Maire & Politis, 1940). Recorded only once in this forest (Zervakis et al. 1998).

*****Russula undulata*** Velen.
Collected in July 2001 (S3). Characteristic of this member of section *Russula* sect. *Atropurpurinae* is the deep to almost blackish purple color of the pileus, the white, graying stipe, the white spore-print and the moderately acrid taste.

Schizophyllum commune Fr.
Quite rare in this forest recorded during the autumn.

Schizopora paradoxa (Schrad.) Donk
Common, recorded during the spring and the autumn on fallen branches, porose on the upper surfaces, porose-irpicoid on the vertical and underside surfaces. Surprisingly, there are only three previous records on *Pinus nigra* and *Fagus* spp.

†***Scleroderma citrinum*** Pers.
Recorded in October 1996 (S2). Only one previous report in *Quercus* forests (Diamandis 1992).

*****Scytinostroma portentosum*** (Berk. & M.A. Curtis) Donk
Collected in June 1999 (S2) in dried condition from rotten wood. This species is well characterized by the dimitic hyphal system with clampless generative hyphae, dextrinoid

vertically arranged (frequently dendrically branched) skeletal hyphae, the abundant dendrohyphidia and the subglobose (5-6 μm), hyaline, thin-walled, amyloid spores (Hallenberg 1985). In Greece, the submediterranean species *S. aluta* Lanq. has been previously recorded (Minter 1988).

†***Spongipellis delectans*** (Peck) Murrill
It was collected in September 1999 from the cavity of a dead trunk (S1), and this is the first record on *Fagus* for Greece. It has previously been reported by Heufler (1868) as *Polyporus schulzeri* Kalchbr. from the Ionian islands.

Stereum hirsutum (Willd.) Gray
Common on dead, fallen branches during the spring and the autumn. Very common in Greece on a large range of hosts.

†***Stereum ochraceoflavum*** (Schwein.) Ellis
Recorded early in October 1998 on fallen branches (S2). It is distinguished from *S. hirsutum* macroscopically by the gray-ochre hymenium and microscopically by the longer spores. The young pilei present a characteristic cyphelloid form. Uncommon on beech, only two previous reports from *Quercus* in Greece (Minter 1988, Diamandis 1992).

†***Stereum rugosum*** (Pers.) Fr.
Only two reports from *Quercus* wood before this authors' record on *Fagus* (Zervakis et al. 1998) in October 1995.

****Stereum subtomentosum*** Pouzar
Recorded in clusters on a stump, early in September 1999 (S1). Easily recognized from the definitely pileate form attached to the substrate by a narrow, short, stipe-like base.

Stropharia aeruginosa (M.E. Curtis.) Quél.
Numerous reports from different types of forests but not common in this forest, recorded at the end of October 1998.

****Stropharia caerulea*** Kreisel
This species is considered as a double of *Stropharia aeruginosa*, but it differs macroscopically in having only a fragmentary annulus (even when young) and lamellae edges concolorous to the lamellae. Collected in October 1998 (S3).

†***Stropharia coronilla*** (Bull.) Quél.
Rare species recorded once in this forest (Zervakis et al. 1998). Two previous reports from fields (Maire & Politis 1940, Diamandis 1992).

†***Stropharia semiglobata*** (Batsch) Quél.
Recorded in October 1998, among herbs, on manured ground, in forest clearings (S1). Several records in Greece on the dung of various animals.

Stropharia squamosa (Pers.) Quél.
The most common *Stropharia* species, regularly recorded in this forest during September-October. Surprisingly enough there has been only one report before, again from *Fagus* woods (Diamandis, 1985).

****Stropharia thrausta*** (Schulzer) Sacc.
Similar microscopically to *S. squamosa* but with an orange-red pileus. Collected for the first time in autumn 1997, it seems that it appears annually but sporadically (S3). Recently recorded also in Andros island (Polemis et al. 2001)

†***Terana caerulea*** (Lam.) Kunze
Very rare on *Fagus*, recorded only once in the investigated beech forest (Zervakis et al. 1998). Elsewhere rather common on *Quercus* spp.

Trametes gibbosa (Pers.) Fr.
Rare species recorded once in October 1995 (Zervakis et al. 1998). Only one record before (Diamandis 1983).

Trametes hirsuta (Fr.) Pilát
Fresh basidiomata recorded in spring and autumn. Common.

Trametes versicolor (L.) Pilát
Common on standing stumps during the autumn. Very common in Greece on a wide range of hosts.

*****Tyromyces chioneus*** (Fr.) P. Karst.
This white-rot fungus, with the characteristic aromatic odor of the fresh basidiomata, has been collected during autumn 1999, from the vertical sides of standing stumps, but also from an horizontal cut in a rosette-like form (S2, S3). After the transfer of other species previously reported as *Tyromyces* (causing brown rot) to the genus *Oligoporus*, this is the only *Tyromyces* species occurring in Greece.

Xerocomus chrysenteron (Bull.) Quél.
Previously recorded only in the *Fagus* forest of Pilion Mt. (Pantidou & Gonou 1984, Zervakis et al. 1998), once in *Quercus* forests (Zervakis et al. 2002b), and quite often in coniferous forests. Rather common during October.

†***Xerocomus truncatus*** Singer, Snell & E.A.Dick
Xerocomus truncatus is considered identical to *X. chrysenteron*, and it is distinguished only by its apically truncate (often indented) spores. Our collections both from *Fagus* and from *Abies* differ from *X. truncatus* typical description in having distinctly broader spores [6-8 (-9) μm width instead of 4-6.5 μm, becoming broadly ellipsoid to rhomboid]. Recorded in October 1999 and in June 2000 (S1). Only one previous record of *X. truncatus* from *Abies cephalonica* forests (Pantidou 1980). Probably not rare, but overlooked as *X. chrysenteron*.

Xerula pudens (Pers.) Singer
Rare, recorded once in October 1998. Diamandis (1992) in his field-book reported *Oudemansiella longipes* from *Fagus* forest which probably corresponds to *X. pudens*. Many other records from *Abies* forests under the name *O. longipes* obviously refer to *Xerula melanotricha*, which occurs in conifers.

Xerula radicata (Relhan) Singer
Common, recorded during the entire autumn period (September-November). Recorded exclusively in *Fagus* forests in Greece except Athanasiou & Theochari's (1999) report from *Pinus nigra*, which is apparently a misidentification.

*****Xerula xeruloides*** (Bon) Dörfelt
Rare species, collected twice in June 2000 and July 2001, under trees (S1, S3). Pileus 2.5-5 μm in diameter, initially campanulate, latter plane to convex, smooth or radially wrinkled, beige to cream-whitish; lamellae white, broad and distant; stipe cylindrical 2.5-7.5 x 0.4-0.6 cm, broadening (up to 1.2 cm) towards a spindle-shaped base, deeply rooting (at least at a length equal to that of the stipe); spores elliptical 15-20 x 10-11.5 μm; cheilocystidia slender clavate, mostly fusiform; pleurocystidia broadly clavate with flattened top 75-125 x 22-30 μm; setae on the pileipellis pointed, with thick and rough walls, setae on the stipe thin-walled and top-rounded. Although in the literature it is reported to occur in coastal areas (Moser 1983), the macroscopic and microscopic features of our collections fit that of Moser's key except the spore size. According to Dörfelt (1983), who has established the correct spore size after examination of the holotype, this is a well-characterized species.

DISCUSSION

Greece possesses a particularly high plant diversity thanks to its geographical position, and its geomorphologic and microclimatic variability. However, our knowledge on the Greek mycoflora is very poor (Zervakis 2001), and the recorded number of macrofungi is limited to ca. 1,200 species (Zervakis & Dimou 2001).

During the last ten years, we have conducted an intensive and detailed investigation on the mycodiversity of selected ecosystems in Greece (including the Oxya Mt., the Taygetos Mt., several Aegean islands, etc., as well as forests with a dominant type of host-plant). Oxya Mt. drew our interest as an investigation area of priority for two reasons. Firstly, because the compact beech forest located there forms the southernmost limit of the *Fagus* distribution in the Balkan peninsula. Secondly, because the distribution of three different forest types (*Fagus-Abies-Quercus*) in three distinct belts on the NE side of mountain provides the opportunity for comparative evaluation of the accumulated data.

During this study 213 species (classified in 100 genera) of macrofungi were recorded: 16 were ascomycetes and 197 basidiomycetes. Sixty five species and varieties and 11 genera (underlined in the following list) are reported for the first time from Greece: *Agaricus macrosporus*, *A. mediofuscus*, *A. pampeanus*, *Amanita franchetii*, *A. submembranacea*, *Boletus radicans*, *B. reticulatus*, *Botryohypochnus isabellinus*, *Byssoporia terrestris*, *Ceriporiopsis subvermispora*, *Clitocybe catinus*, *C. obsoleta*, *C. gibba* var. *gibba*, *Conocybe pilosella*, *C. rubiginosa*, *C. semiglobata*, *C. siliginea*, *Coprinus sylvaticus*, *C. xanthothrix*, *Cortinarius cinnabarinus*, *Crustomyces subabruptus*, *Dentipellis fragilis*, *Endoptychum agaricoides*, *Geastrum schmidelii*, *Gloeocystidiellum leucoxanthum*, *Gyromitra gigas*, *Hyphodontia aspera*, *H. barba-jovis*, *Inonotus nodulosus*, *Laccaria laccata* var. *pallidifolia*, *Lepiota alba*, *Leucocortinarius bulbiger*, *Melanoleuca evenosa*, *M. humilis* var. *blanda*, *M. iris*, *M. pseudoevenosa*, *M. subbrevipes*, *Mycena niveipes*, *M. stylobates*, *Mycenastrum corium*, *Peziza moravecii*, *Oligosporus hibernicus*, *O. subcaesius*, *O. tephroleucus*, *Oxyporus corticola*, *Oudemansiella ephippium*, *Phanerochaete tuberculata*, *Phlebia livida*, *Pholiota tuberculosa*, *Physisporinus vitreus*, *Pleurotus dryinus*, *Pluteus petasatus*, *P. salicinus*, *Polyporus badius*, *P. melanopus*, *Psathyrella pannucioides*, *P. murcida*, *Russula undulata*, *R. cyanoxantha* var. *cyanoxantha*, *Scytinostroma portentosum*, *Stereum subtomentosum*,. *Stropharia caerulea*, *S. squamosa* var. *thrausta*, *Tyromyces chioneus*, *Xerula xeruloides*. Two more new records for Greece (*Hymenoscyphus virgultorum*, *Pleurotus pulmonarius*) from the same forest were reported in previous papers of the authors (Zervakis & Balis 1996, Zervakis et al. 1999). Moreover, 62 taxa (11 of which were included in Zervakis et al. 1998, 1999) were recorded for the first time in *Fagus* woods (*Agrocybe praecox*, *Bovista nigrescens*, *B. plumbea*, *Clavariadelphus pistillaris*, *Coniophora arida*, *C. radians*, *Cortinarius pseudosalor*, *C. trivialis*, *Entoloma hirtipes*, *Ganoderma carnosum*, *G. pfeifferi*, *Hebeloma crustuliniforme*, *Helvella crispa*, *Hyaloscypha hyalina*, *Hygrophorus cossus*, *Hyphoderma praetermissum*, *L. ventriosospora*, *Lyophyllum connatum*, *Macrolepiota excoriata*, *Marasmius wynnei*, *Melanoleuca brevipes*, *Meripilus giganteus*, *Morchella elata*, *Mycena capillaris*, *M. flavescens*, *M. haematopus*, *M. inclinata*, *M. polygramma*, *Panaeolus rickenii*, *Phanerochaete sordida*, *Pholiota alnicola*, *P. highlandensis*, *Pluteus nanus*, *Psathyrella conopilus*, *P. tephrophylla*, *Pulcherricium caeruleum*, *Ramaria flavescens*, *Scleroderma citrinum*, *Spongipellis delectans*, *Stereum ochraceoflavum*, *Stereum rugosum*, *Stropharia coronilla*, *S. semiglobata*, *Xerocomus truncates*) or in alpine areas (*Agaricus campestris*, *Calocybe carnea*, *Coprinus cinereus*, *Handkea utriformis*, *Lepiota castanea*, *L. clypeolaria*, *Macrolepiota mastoidea*) in Greece.

Three records (*Agaricus silvicola*, *Melanoleuca melaleuca* and *Calocera viscosa*) from the mixed *Fagus-Abies* area (S1) reported as *Fagus* inhabitants in the authors' previous paper (Zervakis et al. 1998), are well known from coniferous forests only and for this reason they will be included in the forthcoming inventory from the *Abies* forest in Oxya Mt.

In this long term study, fungi of different habit, seasonality, duration and annual periodicity are being recorded and the results are being evaluated for mapping purposes and for the future compilation of red-data lists. This approach revealed several new taxa in the *Fagus* forest of Oxya Mt., some of which proved to be rare in occurrence and perhaps heavily dependent on the climatic conditions. For example, the recording of *Endoptychum agaricoides* after foraying this particular area for ten consecutive years seems to be connected with the increasing drought of the last years, and the predominance of conditions which favor the appearance of secotioid fungi (Thiers 1984). The same could be suggested for the gasteromycete *Mycenastrum corium*. Moreover some interesting unexpected incidents were recorded, i.e. the extreme abundance of *Oudemansiella mucida* and *Armillaria* spp. during the autumn of 1998, as compared to their poor presence in 1999 and the almost complete absence of any *Armillaria* specimens in 2000.

Considering the frequency of recording and the abundance, the recorded in this forest macrofungi could be divided into three groups as follows:

A. very common (recorded every year, abundant): *Agaricus pampeanus, Amanita muscaria, Armillaria gallica, Biscogniauxia nummularia, Bisporella citrina, Bjerkandera adusta, Clitocybe nebularis, Coprinus comatus, Fomes fomentarius, Ganoderma applanatum, Handkea utriformis, Hypholoma fasciculare, Hypoxylon fragiforme, Lycoperdon perlatum, Macrolepiota procera, Marasmius alliaceus, Oudemansiella mucida, Pholiota cerifera, Pleurotus pulmonarius, Schizopora paradoxa, Stereum hirsutum, Stropharia squamosa, Trametes versicolor, Xerula radicata, Xylaria hypoxylon.*

B. common (recorded almost every year, not or moderately abundant): *Bovista nigrescens, B. plumbea, Calocera cornea, Clitocybe odora, Coprinus micaceus, Diatrype disciformis, Hypholoma sublateritium, Lepiota clypeolaria, Lycoperdon echinatum, Lycoperdon pyriforme, Macrolepiota mastoidea, Marasmius wynnei, Mycena crocata, M. galericulata, M. haematopus, M. pura, M. rosea, Peziza arvernensis, Pleurotus ostreatus, Polyporus arcularius, P. varius, Psathyrella candoleana, Pseudoclitocybe cyathiformis, Russula cyanoxantha var. cyanoxantha, Xerocomus chrysenteron.*

C. rare (recorded 1-2 times or more times but always in the same 1-2 positions): *Agaricus arvenensis, A. bisporus* var. *bisporus, A. campestris, A. macrosporus, A. mediofuscus, Agrocybe praecox, Amanita franchetii, A. submembranacea, Armillaria mellea, Boletus edulis, B. radicans, B. reticulatus, Botryohypochnus isabellinus, Byssoporia terrestris, Calocybe carnea, Ceriporiopsis subvermispora, Clavariadelphus pistillaris, Clitocybe catinus, C. gibba* var. *gibba, C. obsoleta, Collybia butyracea, Coniophora arida, Conocybe pilosella, C. rubiginosa, C. siliginea, Coprinus cinereus, C. disseminatus, C. radians, C. silvaticus, C. xanthothrix, Cortinarius alboviolaceus, C. amoenolens, C. cinnabarinus, C. pseudosalor, C. trivialis, Crepidotus mollis, C. sphaerosporus, Crustomyces subabruptus, Dentipellis fragilis, Endoptychum agaricoides, Entoloma hirtipes, Entoloma sinuatum, Ganoderma australe, Ganoderma carnosum, G. pfeifferi, Geastrum schmidelii, Gloeocystidiellum leucoxanthum, Grifola frondosa, Gyromitra gigas, G. infula, Hebeloma crustuliniforme, H. sinapizans, Helvella crispa, H. lacunosa, Hericium coralloides, H. herinaceus, Hydnum repandum, Hygrophorus cossus, H. eburneus, Hymenochaete rubiginosa, Hyphoderma praetermissum, Hyphodontia aspera, H. barba-jovis, H. subbrevipes, Hypsizygus tessulatus, Inocybe geophylla* var. *lilacina, Inonotus nodulosus, Laccaria amethystina, L. laccata, L. laccata* var. *pallidifolia, Lacrymaria lacrymabunda, Lactarius blennius, L. circellatus, L. deliciosus, L. piperatus, L. vellereus, Laetiporus sulfureus, Lentinellus flabelliformis, Lepiota alba, L. castanea, L. cristata, L. ventriosospora, Lepista flaccida, L. nuda, Leucocortinarius bulbiger, Lycoperdon foetidum, Lyophyllum connatum, Meripilus giganteus, Macrolepiota excoriata, M. rhacodes* var. *hortensis, Melanoleuca brevipes, M. evenosa, M. humilis* var. *blanda, M. iris, M. pseudoevenosa, Merulius tremellosus, Morchella elata, Mycena arcangeliana, M. capillaris, M. flavescens, M. inclinata, M. niveipes, M. polygramma, M. stylobates, Mycenastrum corium, Oligoporus hibernicus, O. subcaesius, O. tephroleucus, Oudemansiella ephippium, Oxyporus* *corticola*, *Panaeolus rickenii*, *Panellus stypticus*, *Peniophora incarnata*, *Peziza micropus*, *P. moravecii*, *Phallus impudicus*, *Phanerochaete sordida*, *P. tuberculata*, *Phlebia livida*, *P. rufa*, *Pholiota alnicola*, *P. highlandensis*, *P. tuberculosa*, *Physisporinus vitreus*, *Pleurotus dryinus*, *Pluteus nanus*, *P. petasatus*, *P. salicinus*, *Polyporus badius*, *P. melanopus*, *Psathyrella conopilus*, *P. murcida*, *P. pannucioides*, *P. tephrophylla*, *Pulchericium caeruleum*, *Ramaria aurea*, *R. flava*, *R. flavescens*, *Russula cyanoxantha* var. *peltereaui*, *R. delica*, *R. undulata*, *Schizophyllum communae*, *Scleroderma citrinum*, *Scutellinia scutellata*, *Scytinostroma portentosum*, *Spongipellis delectans*, *Stereum ochraceoflavum*, *S. rugosum*, *S. subtomentosum*, *Stropharia aeruginosa*, *S. caerulea*, *S. coronilla*, *S. semiglobata*, *S. squamosa* var. *thrausta*, *Trametes gibbosa*, *T.hirsuta*, *Tyromyces chioneus*, *Xerocomus truncatus*, *Xerula pudens*, *X. xeruloides*.

It is worth mentioning that *Tricholoma* species have not been found yet in this *Fagus* forest as opposed to the *Abies* forests of the Oxya Mt. (relevant data will be published in the second part of the study on the mycodiversity of the Oxya Mt.). This fact emphasizes the very poor occurrence of this genus in the Greek *Fagus* forests. Indeed only five species has been recorded: *Tricholoma flavovirens* (Fr.) Lund. (Pantidou 1973), *T. squarrulosum* Bres., *T. sulphureum* (Bull.: Fr.) P. Kumm. (Pantidou & Gonou 1984) in Pilio Mt., and *T. sejunctum* (Sowerby: Fr.) Quél. (Diamandis & Perlerou 1990), *T. columbetta* (Fr.) P. Kumm. (Diamandis & Perlerou 1994) in Olympos Mt.

Macrofungi from Greek *Fagus* forests have been occasionally reported from several authors (Diapoulis 1939, Maire & Politis 1940, Diamandis 1983; 1985, Pantidou & Gonou 1984, Avtzis & Diamandis 1988, Minter 1988, Diamandis & Perlerou 1990; 1994, Constantinidis 1994, Tsopelas 1999, Zervakis et al. 1998, Zervakis et al. 1999). Although most of these studies are incomplete and important data (e.g. area of origin, season of record, etc.) are lacking, their comparative evaluation in respect to the results of this work was attempted in the respective species entries above. Despite its biogeographical importance, the *Fagus* forest in Oxya Mt. did not attract the interest of researchers until now. Only six taxa, *Boletus* (*Tubiporus*) *calopus*, *Russula cyanoxantha*, *Russula xerampelina*, *Pleurotus ostreatus* (*salignus*) and *Xerula* (*Mucidula*) *radicata* (Maire & Politis 1940) and *Armillaria gallica* (Tsopelas 1999), have been reported before from this forest (in parenthesis the synonyms under which they were originally reported).

Many of the species recorded in this forest are cosmopolitan or typical of the Mediterranean region, but some others extend to the south of their known distribution limits for Europe. This is the case for *Endoptychum agaricoides* and *Mycenastrum corium*, or for the new records of the polypores *Byssoporia terrestris*, *Ceriporiopsis subvermispora*, *Inonotus nodulosus*, *Oligoporus simani*, *O. subcaesius*, *O. tephroleucus*, *Oxyporus corticola*, *Physiporinus vitreus*, *Polyporus badius*, *P. melanopus* and *Tyromyces chioneus* and the corticiaceous species *Botryohypochnus isabellinus*, *Crustomyces subabruptus*, *Gloeocystidiellum leucoxanthum*, *Hyphodontia barba-jovis*, *Hyphodontia aspera*, *Phanerochaete tuberculata*, *Phlebia livida*, and *Scytinostroma portentosum*. Two species (*Byssoporia terrestris* and *Ceriporiopsis subvermispora*) were recorded for the first time on *Fagus* in Europe. Noteworthy is also the recording of species previously known to occur mainly in coastal areas (i.e. *Xerula xeruloides*, *Geastrum schmidelii*).

This particular research is still under progress, and it is expected that additional information will soon be obtained on the occurrence of macrofungi in *Fagus* forests. Such type of detailed and long-term collected data will be valuable not only for evaluating the repercussions of the human activities (e.g. logging or uncontrolled mushroom picking) on the mycodiversity of natural ecosystems, but for introducing a much needed catalogue of endangered species in Greece as well.

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DISTRIBUTION OF BATTARREA PHALLOIDES IN MEXICO

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ABSTRACT

The distribution of *Battarrea phalloides* in Mexico is presented. Actually it is only known from the north and central part of the country. It has been usually collected in arid and semiarid areas and several times associated with *Schinus molle* in urban zones of different Mexican states. The largest basidiomata were observed on the floodplain of the Tastiota estuary associated with halophilic vegetation.

Key words: Chorology, Taxonomy, Tulostomatales, Battarreaceae.

INTRODUCTION

First records of *Battarrea* in Mexico date from the ending 1950's (Guzmán, 1958; Herrera, 1959). These collections were from the Mexican states of Baja California Sur and Estado de Mexico. Several authors have considered *B. stevenii* a synonym of *B. phalloides* (Hollós, 1904; Rea, 1942; Kreisel, 1987). However, according to other authors (Cunninghan, 1932; Bottomley, 1948; Calonge, 1998), *B. phalloides* has abundant gelatinous material within the universal veil in the egg stage, versus a permanent pergameneous volva and bigger basidiomata in *B. stevenii;* considering these characters enough to separate them in two species, even though both taxa are similar when mature. Recently, Martin & Johannesson (2000) studied 35 basidiomata from Mexico and several countries of Europe, based on macroscopic and microscopic characters and molecular biology. These authors had not found morphological differences to support the separation of the two taxa. Moreover at molecular level, the amplifications of ITS regions and 5.8S rDNA suggested that both taxa belong to the same species. Based on the previous work, we considered herein all studied specimens as *B. phalloides.* The distribution and ecology of this species in Mexico is presented.

MATERIAL AND METHODS

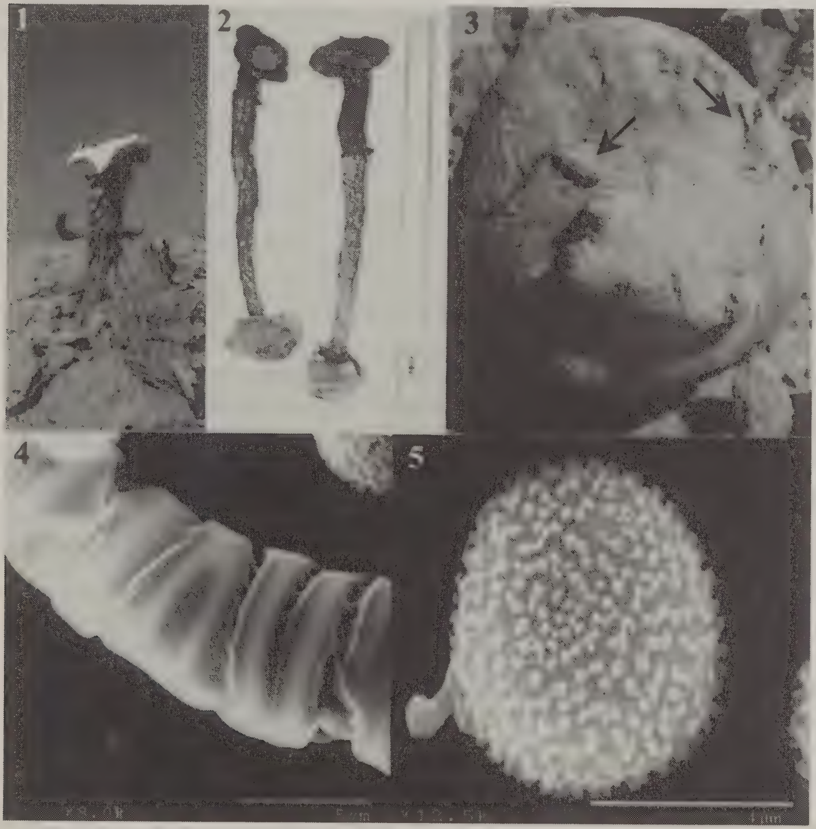
The microscopical features of the basidioma were analyzed according to Moreno *et al.* (1995). Electronic micrographs were made under a Jeol, JSM-5200. The material studied is deposited in the National Herbarium of the Instituto de Biologia, UNAM (MEXU); and Herbaria of the Escuela Nacional de Ciencias Biológicas (ENCB), Instituto de Ecología (XAL) and Universidad de Guadalajara (JAL); and the mushroom collection of the Centro de Estudios Superiores del Estado de Sonora (CESUES).

DESCRIPTION

Battarrea phalloides (Dicks.: Pers.) Pers., *Synops. Meth. Fung.*: 129 (1801). (Figs. 1-5)

Basidioma 10-65 cm high including the spore sac (Figs. 1-2). **Spore sac** 2-12 x 1-8 cm, subglobose, with circumscissile dehiscence. **Exoperidium** missing. **Endoperidium** smooth, papyraceous to coriaceous, grayish white to cinereous, consisting of hyphae 3-9 µm diam.., densely interwoven, walls less than 1 µm thick, septate, branched, pale yellow, with clamp connections. **Stipe** 7-50 cm long, 0.5-9 cm broad, pale brown to brown, woody, surface fibrous-scaly, often shaggy, hollow. **Gleba** brown-ferruginous, exposed by shedding of the peridial cap. **Volva** up to 15 x 13 cm, sac-shaped, free, fragile, formed by two distinct and separated layers: the inner layer appears similar to the scales of the stem, consisting of hyphae 3-18 µm diam., closely arranged nearly parallel, septate, sparsely branched, yellowish ochre, with clamps at some septa; the outer layer is thicker, membranous, sometimes suberous when dry, dirty white, consisting of intertwined hyphae, pale yellow, difficult to distinguish individually, without remains of a gelatinous matrix (Fig. 3).

Gleba with two types of threads: **pseudocapillitium** with hyphae up to 5 µm diam, mostly thin walled, smooth, septate, sparsely branched, hyaline to pale yellow, with clamps; and **elaters** 3.5-7 µm diam, 32-70 µm long, cylindrical, tapered, with spiral thickenings, smooth wall, pale yellow, aseptate, not branched (Fig. 4).



Figs. 1-5. **Battarrea phalloides**. 1-2. Basidiomata. 3. Volva decomposing by termites. 4. Elater under SEM. 5. Basidiospore under SEM.

Basidiospores 5-7 x 4.5-6 µm including ornament, globose, subglobose to elliptical, thick-walled, yellowish to yellow-brown; with a short and smooth pedicel; densely verruculose, under the SEM the spore ornamentation appearing as uniform warts or columns (Fig. 5). Sometimes warts appear united in small crests to form anastomosing ridges, which might occur in immature spores.

SPECIMENS EXAMINED

BAJA CALIFORNIA: El Sauzal, 10 km north of Ensenada, *leg.* S.A. Guzmán del Proo, 26.V.1964 (ENCB). Hermosa beach, 6 km south of Ensenada, *leg.* N. Ayala 381, 26.IV.1984 (XAL). Jacarandas ranch, km 31 Ensenada - Santo Tomás highway, *leg.* M. Lizárraga, 7.II.1993 (BCMEX 4877). Asunción Bay, *leg.* Lozano, V.1989 (BCMEX 4729). **BAJA CALIFORNIA SUR**: Santo Domingo, Magdalena desert, *leg.* G. Guzmán 1794, 1796, 18.I.1958 (ENCB). San José del Cabo, *leg.* I. Manjarrez, N. Ayala & C. Ochoa, 9.XI.1984 (BCMEX 1280, 2117, 2118). **COAHUILA**: San Pedro de las Colonias Municipality, Ejido San Antonio, *leg.* E. Céspedes, 9.IX.1978 (XAL). **DISTRITO FEDERAL**: Xochimilco, *leg.* M. Pie-Costijoc, IX.1959 (MEXU 1056). near Xochitepec, *leg.* R. Cruz-Cisneros 1799, 20.VIII.1967 (ENCB). Campus of UNAM, *leg.* R. Gutiérrez, 18.VII.1978 (MEXU 12995). **ESTADO DE MÉXICO**: University of Chapingo, National School of Agriculture, *leg.* M.H. Basaldúa, 19.XII.1956 (ENCB); 22.XII.1956 (ENCB); *leg.* G. Guzmán & M.H. Basaldúa 648, 19.V.1957 (ENCB); *leg.* J. Rzedowski, X.1961 (ENCB); *leg.* J.L. Magaña, 1.VI.1975 (ENCB). Tepetzingo ranch, 55 km northwest of México city highway to Teotihuacán, *leg.* J.L. Gudiño, 21.V.1978 (ENCB). Ozumbilla, near Teotihuacán, *leg.* R. Hernández, 25.IX.1966 (MEXU 5771). **GUANAJUATO**: La Noria, 3 km east of San Diego de la Unión, *leg.* T. Álvarez, 25.VI.1959 (ENCB). **HIDALGO**: Actopan Municipality, 1 km east of Actopan, *leg.* J.M. Díaz 50, 12.XII.1969 (ENCB); *leg.* F. Zerón, 24.VIII.1968 (ENCB). Cardonal Municipality, Tolantongo hill, *leg.* J. Rzedowsky, 16.X.1983 (ENCB). Cd. Sahagún Municipality, Tecolotla hill, 2 km south of Cd. Sahagún, *leg.* R. Fernández 1810, 16.IX.1983 (ENCB). Tlanalpa Municipality, 3 km north of Tlanalpa, *leg.* T. Millán, 12.X.1975 (ENCB). Tolantongo Municipality, *leg.* M. Menchaca, 5.IX.1978 (ENCB). Valle del Mezquital, km 104 highway México to Laredo, 14 km from Actopan, *leg.* J. Signoret, X.1968 (MEXU 5828). **MORELOS**: Zempoala Municipality, north slope of Tecajete hill, near of Santa María Tecajete, *leg.* L. Guzmán-Dávalos 145, 20.IX.1981 (ENCB). **NUEVO LEÓN**: Mina Municipality, *leg.* H. Nieto de Villarreal 26, 13.VIII.1967 (XAL); *leg.* J. Ayala-Guajardo, 17.V.1981 (XAL). **PUEBLA**: Tehuacán Municipality, 2 km near of Tehuacán, *leg.* G. Gómez, 20.VIII.1980 (ENCB). 5 km west of Calipan, *leg.* E. Barrera, 2.VII.1992 (MEXU 23496). **SAN LUIS POTOSÍ**: 25 km west of Cd. Valles, *leg.* M.E. Sánchez 114-B, 11.IX.1967 (ENCB). Villa de Arista crossroad, central highway to San Luis Potosí, *leg.* A. Gómez, 22.II.1962 (ENCB). **TLAXCALA**: San Felipe Ixtacuixtla, *leg.* González-Fuentes, 7.XII.1985 (XAL). **SONORA**: Empalme Municipality, La Atravesada, 20 km southeast of Guaymas city, *leg.* A. Topete, 18.II.1987 (JAL). Hermosillo Municipality, 6 km east of Tastiota, 28°23'24"N 111°25'13" W, *leg.* A. Aparicio, 04.III.1990 (CESUES 4861); 25.IX.2001 (CESUES 4862).

San Jorge ranch, *leg.* R. Corral, 08.IX.2001 (CESUES 4860). Sonoyta ...unicipality, 3 km northeast of Sonoyta, *leg.* T. Álvarez, 1.VII.1958 (ENCB). **VERACRUZ**: Huayacocotla Municipality, *leg.* R. Hernández & R.C. Trigos, 23.X.1970 (MEXU 7573).

HABIT AND HABITAT

Solitary, scattered, and gregarious; mainly solitary. It may be found from sea level, on coastal dunes, to up to 2550 m. It is associated with *Lycium brevipes*, *Solanum hindsianum*, *Salicornia subterminalis, Atriplex linearis, Quercus agrifolia* and *Opuntia* sp., in coastal dunes. It grows in the shadow of *Prosopis,* other leguminous plants and cacti, in arid and semi-arid areas. It has been frequently collected in the shadow of *Schinus molle* in urban zones; solitary and gregarious in the shadow of *Cupressus* in urban zones; also among corn crops, and grassland. A collection was found in a tropical deciduous forest, but most of the studied specimens were from xeric habitats and sandy soils.

The largest basidiomata of *Battarrea* from Mexico were observed on the floodplain of the Tastiota estuary, located in Hermosillo, Sonora. This area is covered by halophilic vegetation: *Atriplex barclayana, Frankeria palmeri, Jatropha cinerea, Maytenus phyllantoides,* and *Salicornia pacifica*. Also, there are cacti like *Carnegiea gigantea, Lemaireocereus thurberi*, and *Lophocereus schottii* in this salty environment (COTECOTA, 1986). A basidioma was collected between two decaying logs of *Prosopis* and its volva was decomposing by termites (Fig. 3). The soils had a 48-50% of clay, 26-28% of lime, and 24% of sand; a pH of 7.8, and a total organic matter of 1.5%; electric conductivity of 66 mmhos/cm^3, being the content of Na 595 meq/L. The contents of NO_3^- and $PO_4^{\equiv}$ were 1.2 and 2.6 mg/kg, respectively. The region has a very dry climate BW(h')hw(x'); along the year, the temperature is between 14 and 39°C; and annual rainfall is lower than 200 mm (SPP, 1981).

DISCUSSION

Battarrea is a cosmopolitan genus, but with individual plants usually rare and widely dispersed. Although originally described from the British Isles it is probably more frequent in other regions of Europe. It is rare in Britain and confined to a southerly distribution (Pegler *et al.*, 1995). It appears to have a more southerly distribution, occuring in mediterranean and subtropical areas (Mornand, 1989; Calonge, 1998). It is also known from the other continents: America; with distribution from almost Alaska to South America. Asia; Caucasus to Siberia and Mongolia. Africa; South to North and Central Africa in semi-arid and temperate grasslands and savannah. And Australia (Watling *et al.,* 1995). It seems that *Battarrea* specimens with the gelatinous volva, are confined to northern, cooler, more humid regions, which they outline; while the specimens with dry volva, are confined to southern, subtropical, hot, dry regions.

All Mexican collections studied had not a dry exoperidium. Small and large forms were present in Mexico being the largest ones from the Sonoran littoral zone. Perreau (1986) suggested that exoperidium nature may vary according to climatic conditions, and noted that no specific distinction can be made on microscopic characters. Cunningham (1932) noted that all the specimens found in Australia had a nongelatinous volva. Although, Moreno *et al*. (1995) observed a great variability in size among *Battarrea* collections from Baja California, Mexico and Spain, they had never observed a gelatinous volva. Furthermore, after studying the gleba under SEM significant differenceswere not demostrated. Hollós (1904) defended the idea of a single polymorphic species based in the analyses of specimens of all over the world.

Rea (1942) never observed a mucilaginous volva after studying several collections from southern California, and concluded that *B. stevenii* should become a synonym of *B. phalloides*. The specimens from the Californian coast, in a very mild and equable climate, conformed in a striking manner with the traditional characters of *B. stevenii*, while those from the Mojave desert with *B. phalloides*. This difference in habitat appears to be diametrically opposed to the theory of Maublanc & Malencon (1930). The largest *Battarrea* of Mexico (over 60 cm) were collected in a shore of Coast of Hermosillo, Sonora; and the more robust form (35 cm long x 12 cm diam) from an arid area of Hidalgo. Although these collections were found in opposite environmental conditions, both of them had a dry volva. Generally, Mexican collections are between 10 to 20 cm long.

Battarrea is used by Paiute indian group from Nevada as a poultice for swellings and sores (Burk, 1983). Felger & Moser (1991) provided information about the employment of *Battarreoides diguetii,* a species taxonomically close to *B. phalloides,* by Seri indians from the Coast of Hermosillo, Sonora, to cure cuts, sores, or burns by applying the ground gleba. Perhaps Seri indiscrimately use *B. diguetii* and *B.*

phalloides as medicinal mushroom because when mature, after loosing the peridium, both species are very similar. Besides, *B. phalloides* is more commonly found than *B. diguetii* at the Coast of Hermosillo.

Fortey (1998) observed that *Battarrea* often seems to occur on dry banks and sandy soil, but has been described as occurring inside or outside old, often hollow trunks of various species of trees, both broadleaved and coniferous. The last behavoir has not been observed in Mexico, but its distribution in dry and sandy soil is very common. States (1990) reported it as quite frequent in the Great Basin, western United States, where it occurs in sandy soils. This region has a rather extreme climate. It may be that the dryness of the location is more important to the success of the fungus than a sandy soil. In several areas around the world, it seems that mycelium is evidently very long-lived, since fruiting bodies have appeared in variable numbers year after year for more than 20 years. Apparently the basidioma develops very rapidly (Watling *et al.*, 1995).

Jacobson *et al.* (1999) observed 74 basidiomata of *Battarrea* on the floodplain of the ephemeral Kuiseb River in western Namibia. It is a common associate of riparian forests on silty more than 15% floodplain terraces, but does not form mycorrhizal associations with the dominant *Faidherbia albida* or *Tamarix usneoides.* Basidioma production occurs 4.5-12 months post-flooding in response to soil desiccation at depth of 20-35 cm. Large size and abundance of sporocarps suggest that it is an important component of the subsurface decomposer community in the Namib's ephemeral rivers. Because the fungus has also been recorded from floodplain soils of Angola, Hungary, and New Mexico, authors predict that *Battarrea* is a characteristic element of the riparian biota in dryland river systems.

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ANNOTATED CHECK LIST OF WOOD-ROTTING BASIDIOMYCETES OF HAWAI`I

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SUMMARY

One hundred and sixty genera and 400 species of wood-rotting basidiomycetes are reported from 110 native and exotic substrate species on the Hawaiian Islands of Hawai`i, Kaua`i, Lāna`i, Maui, Moloka`i, and O`ahu. Forty-one (10.25% of the total) fungal species are considered to cause brown rots. This is approximately the same percentage of brown rot fungi reported in the North American wood-rotting basidiomycetes.

Key words: Wood-rotting fungi.

INTRODUCTION

The first recorded mycological field research in the Hawaiian Islands dates from 1845-47, when a Danish botanist, Didrik Ferdinand Didrichsen, visited the Islands as botanist on the Galathea expedition. Didrichsen was a professor of botany at Copenhagen and apparently sent his fungal collections to Elias Magnus Fries. The first wood-rotting fungus described as new from the Hawaiian Islands is a Pyrenomycete, *Xylaria curta*, described by Fries (1851) from a specimen collected by Didrichsen on O`ahu. Twenty-four years later a German botanist, Dr. Heinrich Wawra Ritter von Fernsee, collected more than 800 species of vascular plants, bryophytes, and fungi on several of the main islands of the archipelago from December 1869 to May 1870. His collections are now in the Naturhistorisches Museum in Vienna, Austria. C.W. Reichardt (1877) studied the cryptogams included in these collections and in 1877 reported 24 species of mosses, 9 species of liverworts, and 10 species of fungi. Among the latter are 5 species of wood-rotting basidiomycetes from Kaua`i, Maui, and O`ahu. One of these, *Xerotus mauiensis* Reichardt, is the first wood-rotting basidiomycete described as new from the Hawaiian Islands. Bessey (1943), apparently unaware of the field work by Didrichsen and von Fernsee, states that the first recorded collections of Hawaiian fungi were made in 1895 by A.A. Heller, who collected about two dozen species of fungi incidentally while making a large collection of vascular plants. From 1910 to 1920, C.N. Forbes, a botanist with the Bishop Museum in Honolulu, made numerous collections of wood-rotting basidiomycetes in the Hawaiian Islands. The specimens collected by Heller and Forbes are in the herbarium of the Bishop Museum in Honolulu (BISH). In 1921 F.L. Stevens of the University of Illinois collected fungi on most of the Hawaiian Islands, but mainly on O`ahu. Included in Stevens' collections were 150 specimens of "higher fungi" which he sent to E.A. Burt at the Missouri Botanical Garden. Burt (1923) published the first records of about 45 species of Hawaiian wood-rotting basidiomycetes based on the specimens collected by Heller, Forbes and Stevens. Stevens was mainly interested in foliar pathogens and his large publication on Hawaiian fungi (1925) does not include any wood-rotting basidiomycetes.

Plant pathologists have contributed to knowledge of Hawaiian wood-rotting fungi. Parris (1940) included 46 wood-rotting basidiomycetes in a checklist of fungi, bacteria, nematodes, and viruses in Hawai`i. The USDA Index of Plant Diseases in the United States (Anonymous, 1960) included some Hawaiian records of wood-rotting fungi, mostly taken from the older publications cited above. Raabe and Trujillo (1963, 1966) provided additional records and Raabe et al. (1981) reported 30 species of wood-rotting basidiomycetes in a checklist of plant diseases in Hawai`i. U.S. Forest Service pathologists have investigated and reported basidiomycetes causing trunk rots or rootrots in living trees in Hawai`i (Bega, 1979; Laemmlen and Bega, 1974; Larsen et al., 1985). The records of *Armillaria* in these papers were all attributed to *A. mellea* and cannot be resolved at present as a number of species have now been segregated from the former *A. mellea* complex. The first mycologist primarily interested in wood-rotting basidiomycetes to do extensive field work in Hawai i on all the major islands was D.P. Rogers in 1945-47. During that period he was a faculty member of the University of Hawai`i at Manoa. Approximately 500 of the collections made by Rogers in the Hawaiian Islands are now in the Mycological Herbarium of Washington State University in Pullman, Washington (WS). We have examined these collections and incorporated some records from them in this paper. Although Rogers did not publish on this important resource himself, some of his students and colleagues have utilized his collections in monographic and other studies of wood-rotting basidiomycetes (e.g. Bodman, 1952; Wells, 1959; Boquiren 1971; Liberta, 1973). A few Hawaiian specimens are cited in these publications. Other papers on Hawaiian wood-rotting basidiomycetes prior to 1990 are few. Ueki and Smith (1973) reported 10 species of *Crepidotus* from Hawai`i, and Kennedy and Goos (1983) reported five species of dacrymycetaceous fungi from Hawai`i. Wong and Wells (1987) gave Hawaiian records of three species of *Auricularia*. Farr et al. (1989) provided an extensive check list and host index of fungi on plants and plant products in the United States, but the total number of Hawaiian wood-rotting basidiomycetes is only about 35 species, mostly taken from the publications cited above.

Concerted research and publication on Hawaiian wood-rotting basidiomycetes developed momentum in the decade from 1990 through 1999 and continues into this century (Hemmes and Desjardin, 2001). Beginning in 1990 R.L. Gilbertson became active in field work in Hawai`i when he and J.E. Adaskaveg made about 150 collections of wood-rotting basidiomycetes as an incidental activity during a short visit to the islands of Maui and Hawai`i. This modest collection included 60 species, with 46 previously unreported from Hawai`i including eight new species. The number of species reported (Gilbertson and Adaskaveg, 1993) exceeded the total number known from all of the previous publications since 1851. At about the same time Desjardin and Hemmes began research on the Hawaiian agarics. Since that time, extensive field work on all of the major Hawaiian Islands (except Ni`ihau) by Gilbertson, Hemmes, and Desjardin has resulted in about 5000 collections of non-agaricoid wood-rotting basidiomycetes and 1000 collections of wood-rotting agarics. The records reported in this paper are largely based on these collections, a large number of which are still unidentified and probably include numerous undescribed species. This check list is far from complete and represents our present state of knowledge. Publications after 1990 that provide records of Hawaiian wood-rotting basidiomycetes include Desjardin (1993, 1995), Desjardin et al. (1992, 1999), Gilbertson and Hemmes (1997a, 1997b), Gilbertson et al. (2001), Horak and Desjardin (1993), Horak et al. (1996), Nakasone and Gilbertson (1998), and Nakasone (2000).

SPECIES OF TREES AND SHRUBS RECORDED AS SUBSTRATES

In the following list, botanical and common names of tree species recorded as substrates for Hawaiian wood-rotting fungi are based on Little and Skolmen (1989) and Wagner et al. (1990). For each substrate species, the family also is given along with an acronym for that species. The acronyms consist of the first two letters of the genus name and the first two letters of the species name. In the event two substrate species happen to have the same four letter acronym, they are differentiated by a number as a fifth character. For substrates identified only to genus, the genus name is given. Unidentified substrates are listed as HDWD (hardwood), COWD (conifers), or woodchips. Substrate species with scientific names followed by an asterisk (*) are introduced (or exotic) and are not native to Hawai`i. Those with two asterisks (**) are believed to have been introduced by the early Hawaiians.

ACCO: *Acacia confusa* Merr.*; Formosa koa (Fabaceae). **ACKO**: *Acacia koa* A. Gray; koa (Fabaceae). **ACME1**: *Acacia mearnsii* De Wild.*; black-wattle acacia (Fabaceae). **ACME2**: *Acacia melanoxylon* Br. ex Aiton*; blackwood acacia (Fabaceae). **ALMO**: *Aleurites moluccana* (L.) Willd.**; kukui, candlenut-tree (Euphorbiaceae). **ALNE**: *Alnus nepalensis* D. Don*; Nepal alder (Betulaceae). **ALPU**: *Alpinia purpurata* (Vieill.) K. Schum.*; red ginger (Zingiberaceae). **ANEV**: *Angiopteris evecta* (Forster f.) Hoffm.*; mule foot fern (Marattiaceae). **ANPL**: *Antidesma platyphyllum* H. Mann.; hame (Euphorbiaceae). **ARAL1**: *Archontophoenix alexandrae* (F. Muell.) H. A. Wendl. & Drude*; Alexander palm (Arecaceae). **ARAL2**: *Artocarpus altilis* (Parkins.) Fosb.**;

`ulu, breadfruit (Moraceae). **ARHE**: *Araucaria heterophylla* (Salisb.) Franco*; Norfolk Island pine (Araucariaceae). **BAVU**: *Bambusa vulgaris* Schrad. ex Wendl.*; `ohe, common bamboo (Poaceae). **CACU**: *Casuarina cunninghamiana* Miq.*; river-oak casuarina (Casuarinaceae). **CAEQ**: *Casuarina equisetifolia* L.*; horsetail casuarina (Casuarinaceae). **CAIN**: *Calophyllum inophyllum* L.**; kamani (Clusiaceae). **CEOB**: *Cecropia obtusifolia* Bertol.*; trumpet-tree (Cecropiaceae). **CHOB**: *Charpentiera obovata* Gaud.; pāpala (Amaranthaceae). **CHTR**: *Cheirodendron trigynum* (Gaud.) A. Heller; `ōlapa, common cheirodendron (Araliaceae). **CICH**: *Cibotium chamoissoi* Kaulf.; hāpu`u i`i, Hawaiian treefern (Dickinsoniaceae). **CIGL**: *Cibotium glaucum* (Sm.) Hook. & Arnott; hāpu`u pulu, Hawaiian treefern (Dickinsoniaceae). **CIHA**: *Cibotium hawaiiense* Nakai & Ogura; meu, Hawaiian treefern (Dickinsoniaceae). **CLAR** *Clermontia arborescens* (H. Mann) Hillebr.; `ohawai, haha, tree clermontia (Campanulaceae). **COFR**: *Cordyline fruiticosa* (L.) A. Chev.**; ti (Agavaceae). **COLA**: *Corynocarpus laevigatus* J.R. & G. Forster; karaka (Corynocarpaceae). **COMO**: *Coprosma montana* Hillebr.; pilo (Rubiaceae). **CONU**: *Cocos nucifera* L.**; niu, coconut palm (Arecaceae). **COWD**: conifer wood. **CRJA**: *Cryptomeria japonica* (L. f.) D. Don*; sugi, cryptomeria (Taxodiaceae). **CULA**: *Cunninghamia lanceolata* (Lambert) Hook.*; Chinese fir; (Taxodiaceae). **CUMA**: *Cupressus macrocarpa* Hartw.*; Monterey cypress (Cupressaceae). **CYSC**; *Cytisus scoparius* (L.) Link*; scotch broom (Fabaceae). **DERE**: *Delonix regia* (Bojer ex Hook.) Raf.*; royal poinciana (Fabaceae). **DIHI**: *Diospyros hillebrandii* (Seem.) Fosb.; lama, Hillebrand persimmon (Ebenaceae). **DOVI**: *Dodonaea viscosa* Jacq.; `a`ali`, dodonaea (Sapindaceae). **DUPL**: *Dubautia plantaginea* Gaud.; kūpaoa (Asteraceae). **EPPI**: *Epipremnum pinnatum* (L.) Engel.*; taro vine (Araceae). **ERSA:** *Erythrina sandwicensis* Degener; wiliwili (Fabaceae). **ETEL**: *Etlingera elatior* (W. Jack) R.M. Smith*; torch ginger (Zingiberaceae). **EUGL**: *Eucalyptus globulus* Labill.*; bluegum eucalyptus (Myrtaceae); **EURO**: *Eucalyptus robusta* Sm.*; robusta eucalyptus (Myrtaceae). **EUSA**: *Eucalyptus saligna* Sm.*; saligna eucalyptus (Myrtaceae). **FIMI**: *Ficus microcarpa* L. f.*; Chinese banyan (Moraceae). **FLBR**: *Flindersia brayleyana* F. Muell.*; Queensland-maple, silkwood (Rutaceae). **FRAR**: *Freycinetia arborea* Gaud.; `Ie`ie, (Pandanaceae). **FRUH**: *Fraxinus uhdei* (Wenzig) Lingelsh.*; tropical ash (Oleaceae). **GRRO**: *Grevillea robusta* A. Cunn. ex R. Br.*; silk-oak (Proteaceae). **HDWD**: unidentified hardwood. **HECO**: *Hedychium coronarium* J. König*; `awapuhi ke`oke`o, white ginger (Zingiberaceae). **HEFL**: *Hedychium flavescens* N. Carey ex Roscoe*; yellow ginger (Zingiberaceae). **HITI**: *Hibiscus tiliaceus* L.; hau, sea hibiscus (Malvaceae). **ILAN**: *Ilex anomala* Hook. & Arnott; kāwa`u, Hawaiian holly (Aquifoliaceae). **INED**: *Inga edulis* Mart.*; square fruit tree (Fabaceae). **LELE**: *Leucaena leucocephala* (Lam.) de Wit*; koa haole, leucaena (Fabaceae). **LESC**: *Leptospermum scoparium* J.R. Forst. & G. Forst.*; manuka, tea tree (Myrtaceae). **LICH**: *Livistona chinensis* (Jacq.) R. Br. ex Mart.*; fan palm (Arecaceae). **LOCO**: *Lophostemon confertus* (R. Br.) Peter G. Wilson & Waterhouse*; vinegar tree (Myrtaceae). **MAGL**: *Manihot glaziovii* Müll. Arg.*; Ceará rubber tree (Euphorbiaceae). **MAIN1**: *Mangifera indica* L.*; mango (Anacardiaceae). **MAIN2**: *Macadamia integrifolia* Maiden & Betche*; macadamia nut (Proteaceae). **MAMA**: *Macaranga mappa* (L.) Müll. Arg.*; bingabing (Euphorbiaceae). **MEAZ**: *Melia azedarach* L.*; Chinaberry, pride-of-India (Meliaceae). **MEPO**: *Metrosideros polymorpha* Gaud.; `ōhi`a lehua (Myrtaceae). **MEQU**: *Melaleuca* *quinquenervia* (Cav.) S.T. Blake*; paperback, cajeput-tree (Myrtaceae). **MEUM**: *Melochia umbellata* (Houtt.) Stapf*; melochia (Sterculiaceae). **MESA**: *Meteroxylon sagu* Rottb.*; sago palm (Arecaceae). **MOCI**: *Morinda citrifolia* L.**; noni, Indian mulberry (Rubiaceae). **MUPA**: *Musa* x *paradisiaca* L.**; banana (Musaceae). **MYFA**: *Myrica faya* Aiton*; firetree (Myricaceae). **MYLE**: *Myrsine lessertiana* A. DC; kōlea (Myrsinaceae). **MYSA1**: *Myoporum sandwicense* A. Gray; naio, false sandalwood (Myoporaceae). **MYSA2**: *Myrsine sandwicensis* A. DC; kōlea lau-li`i (Myrsinaceae). **NESA**: *Nestegis sandwicensis* (A. Gray) Degener, I. Degener, & L. Johnson; olopua, pua (Oleaceae). **PAFA**: *Paraserianthes falcataria* (L.) I. Nielsen*; Molucca albizia (Fabaceae). **PATE**: *Pandanus tectorius* S. Parkinson ex Z; hala, screwpine (Pandanaceae). **PEAM**: *Persea americana* Mill.*; avocado (Lauraceae). **PECL**: *Pelea clusiifolia* A. Gray; alani, Clusia-leaf pelea (Rutaceae). **PHNI**: *Phyllostachys nigra* (Lodd. ex Lindley) Munro.*; black bamboo (Poaceae). **PIAL**: *Pipturus albidus* (Hook. & Arnott) A. Gray; mamaki (Urticaceae). **PIBR**: *Pisonia brunoniana* Endl.; pāpala kēpau (Nyctaginaceae). **PIDU**: *Pithecellobium dulce* (Roxb.) Benth.*; `opiuma (Fabaceae). **PIEL**: *Pinus elliotii* Engelm.*; slash pine (Pinaceae). **PIPA**: *Pinus patula* Scheide & Deppe*; jelecote pine (Pinaceae). **PIPI**: *Pinus pinaster* Aiton*; cluster pine (Pinaceae). **PIRA**: *Pinus radiata* D. Don*; Monterey pine (Pinaceae). **PISA**: *Pisonia sandwicensis* Hillebr.; āulu (Nyctaginaceae). **PISI**: *Picea sitchensis* (Bong.) Carr*; Sitka spruce log imported from northwestern North America (Pinaceae). **PITA**: *Pinus taeda* L.*; loblolly pine (Pinaceae). **PLAC**: *Plumeria acuminata* Aiton*; frangipani (Apocynaceae). **PLAU**: *Pleomele aurea* (H. Mann) N.E. Brown; halapepe, golden dracaena (Agavaceae). **PRMA**: *Pritchardia martii* (Gaud.) H.A. Wendl.; loulu (Arecaceae). **PRPA**: *Prosopis pallida* (Humb. & Bonpl. ex Willd.) Kunth*; kiawe, algarroba (Fabaceae). **PSCA**: *Psidium cattleianum* Sabine*; waiawī, strawberry guava (Myrtaceae). **PSGU**: *Psidium guajava* L.*; guava, kuava (Myrtaceae). **PSHA**: *Psychotria hawaiiensis* (A. Gray) Fosb.; kōpiko (Rubiaceae). **PSME**: *Pseudotsuga menziesii* (Mirb.) Franco*; Douglas fir (Pinaceae). **PTMA**: *Pteralyxia macrocarpa* (Hillebr.) K. Schum.; kaulu (Apocynaceae). **SAOF**: *Saccharum officinarum* L.**; sugar cane (Poaceae). **SASA1**: *Samanea saman* (Jacq.) Merr.*; `ōhai, monkeypod (Fabaceae). **SASA2**: *Sapindus saponaria* L.; mānele, wingleaf soapberry (Sapindaceae). **SCAC**: *Schefflera actinophylla* (Endl.) Harms*; octopus-tree (Araliaceae). **SCGL**: *Schizostachyum glaucifolium* (Rupr.) Munro.**; `ohe (Poaceae). **SCTE**: *Schinus terebinthefolia* Raddi*; Christmas-berry (Anacardiaceae). **SESE**: *Sequoia sempervirens* (D. Don) Endl.*; redwood (Taxodiaceae). **SOCH**: *Sophora chrysophylla* (Salisb.) Seem.; mamane (Fabaceae). **SPCA**: *Spathodea campanulata* P. Beauv.*; African tulip-tree (Bignoniaceae). **STTA**: *Styphelia tameiameiae* (Cham. & Schlechtend.) F. Muell.; pūkiawe (Epacridaceae). **SYCU**: *Syzygium cumini* (L.) Skeels*; Java plum (Myrtaceae). **SYJA**: *Syzygium jambos* (L.) Alston*; `ōhi`a loke, rose apple (Myrtaceae). **SYMA**: *Syzygium malaccense* (L.) Merr. & Perry**; `ōhi`a ai, mountain apple (Myrtaceae). **TECA**: *Terminalia catappa* L.*; false kamani, tropical almond (Combretaceae). **TEST**: *Tecoma stans* (L.) Juss. ex Kunth*; trumpet bush (Bignoniaceae). **THPO**: *Thespesia populnea* (L.) Sol. ex Corrêa**; milo, portiatree (Malvaceae). **TIUR**: *Tibouchina urvilleana* (DC) Cogn.*; glorybush (Melastomataceae). **TOCI**: *Toona ciliata* M. Roem.*; Australian toon (Meliaceae). **TROR**: *Trema orientalis* (L.) Blume*; gunpowder-tree (Ulmaceae).

CHECK LIST OF HAWAIIAN WOOD-ROTTING BASIDIOMYCETES

In the following check list the fungi are listed alphabetically by genus. Concepts of families and higher taxa of basidiomycetes have changed drastically in recent years and are controversial today. For current concepts and a key to families see Hawksworth et al. (1995). All of the genera listed here are indexed and the family given in that reference. Two letter acronyms for the names of the Hawaiian Islands are as follows: **HA**- Hawai`i; **KA**- Kaua`i; **LA**- Lāna`i; **MA**- Maui; **MO**- Moloka`i; **OA**- O`ahu. No collections were made on the islands of Kaho`olawe and Ni`ihau. Substrate species are listed by the four letter acronyms given above. Type of rot is listed as white, brown, or uncertain. Fungal species associated with decay in living trees are indicated by #. Authors of fungal names follow Kirk and Ansell (1992). Voucher specimens for fungal species are deposited in the mycological collections of herbaria at the University of Arizona, Tucson, AZ (ARIZ) and San Francisco State University, San Francisco, CA (SFSU). Specimens of non-agaricoid fungal species are at ARIZ and specimens of agaricoid species are at SFSU.

Agrocybe parasitica W.C. Stev.- HA; SASA2; rot uncertain.

Aleurobotrys botryosus (Burt) Boidin, Lanq. & Gilles- HA, KA; ACKO, *Prunus*; white rot.

Aleurocystis magnispora (Burt) Lemke- HA; ACKO, LESC, SASA2; white rot.

Aleurodiscus mirabilis (Berk. & M.A. Curtis) Höhn.- HA, MA, MO, OA; CHTR, EURO, HDWD, MEPO, TOCI; white rot.

Amethicium chrysocreas (Berk. & M.A. Curtis) Sheng H. Wu- HA, KA, LA, MA, MO, OA; ACKO, ALMO, EUGL, EURO, FRUH, GRRO, MAIN1, MEPO, MEQU, PSCA, PSGU, SASA2, TOCI; white rot.

Amphinema byssoides (Pers.:Fr.) J. Erikss.- KA, MA, MO; EURO, PIEL, PIPI, PIRA, PITA; white rot.

Antrodia albida (Fr.) Donk- HA, KA; MEPO, PIEL, PSGU; brown rot.
Antrodia gossypina (Speg.) Ryvarden- HA, MO; ACKO, EURO; brown rot.
Antrodia malicola (Berk. & M.A. Curtis) Donk- HA, KA; ACKO, MEPO; brown rot.
Antrodia odora (Peck ex Sacc.) Gilb. & Ryvarden- HA; MEPO; brown rot.
Antrodia sinuosa (Fr.) P. Karst.- HA, KA, MA; ACKO, MEPO, MYSA1, PIEL; brown rot.
Antrodia vaillantii (DC.:Fr.) Ryvarden- KA, MA; ACME1, conifer post, MEPO, PIEL, SESE; brown rot.

Antrodiella incrustans (Berk. & M.A. Curtis ex Cooke) Ryvarden- HA; HITI; white rot.

#Armillaria sinapina Bérubé & Dessur.- KA; ACKO, COLA; white rot.

#Armillaria aff. ***ostoyae*** (Romagn.) Herink- HA; ACKO, PSHA; white rot.

Asterostroma cervicolor (Berk. & M.A. Curtis) Massee- HA, KA; CRJA, ERSA, MYSA1, MYSA2; white rot.
Asterostroma muscicolum (Berk. & M.A. Curtis) Massee- HA, MA, OA; ARHE, CONU, ERSA, HDWD; white rot.
Asterostroma ochroleucum Bres.- HA, MO; CRJA; white rot.
Asterostroma praeacutisporum Boidin, Lanq. & Gilles- MA, MO; ARHE; white rot.

Athelia arachnoidea (Berk.) Jülich var. ***arachnoidea***- HA; *Cibotium*; white rot.
Athelia bambusae Gilb. & Adask.- MA; PHNI; white rot.
Athelia cibotii Gilb. & Hemmes- HA; CICH, CIGL, CONU; white rot.
Athelia epiphylla Pers.:Fr.- HA; ACKO; white rot.
Athelia pyriformis (M.P. Chris.) Jülich- HA; CICH, CIGL; white rot.

Auricularia cornea Ehrenb.:Fr.- HA, MA, OA; ACKO, ALMO, COMO, ERSA, DUPL, HDWD, MEPO, MYLE, MYSA2, PAFA, PSGU; white rot.
Auricularia polytricha (Mont.) Sacc.- HA, KA, MA, MO, OA; ACKO, ALMO, CEOB, FRAR, HITI, HDWD, MEPO, PLAU, PSGU, SASA1, THPO, TROR; white rot.
Auricularia tenuis (Lév.) Farl.- KA, OA; ACKO, ALMO; white rot.

Basidiodendron caesiocinerea (Höhn. & Litsch.) Luck-Allen- HA, KA, OA; ACKO, MEPO, PIEL; white rot.
Basidiodendron cinerea (Bres.) Luck-Allen- HA, OA; CAIN, HDWD, HITI, MEUM; white rot.
Basidiodendron eyrei (Wakef.) Luck-Allen- HA, KA, MA, MO, OA; ACKO, ALMO, CAEQ, CAIN, CEOB, CUMA, EURO, HDWD, HITI, MYSA1, PAFA, PSGU, SYJA; white rot.
Basidiodendron fulvum (Massee) Ginns- HA; MEPO; white rot.

Botryobasidium ampullatum Gilb. & Hemmes- HA; CICH, CIGL, CIHA; white rot.
Botryobasidium botryosum (Bres.) J. Erikss.- KA, MA; ACKO, EUGL, PIEL, PHNI; white rot.
Botryobasidium candicans J. Erikss.- HA, KA, MA; ACKO, ACME2, COMO, EUGL, EURO, MEPO, PIEL, SOCH; white rot.
Botryobasidium pruinatum (Bres.) J. Erikss.- OA; ALMO; white rot.
Botryobasidium vagum (Berk. & M.A. Curtis) D.P. Rogers- OA; ALMO, COFR, SOCH; white rot.

Botryohypochnus isabellinus (Fr.) J. Erikss.- HA, OA; ACKO, ANPL, CICH; white rot.

Bourdotia aspera (L.S. Olive) K. Wells- HA, MA; HDWD; white rot.
Bourdotia kipukaensis Gilb. & Hemmes- HA, KA, MA; ARHE, CICH, CRJA, MEPO, SCGL, SYJA, SYMA; white rot.

Bourdotia petiolata (D.P. Rogers) K. Wells- HA; SCTE; white rot.

Brevicellicium olivascens (Bres.) K.H. Larss. & Hjortstam- MO; CAEQ; white rot.
Brevicellicium vulcanense Gilb. & Hemmes- HA; MYSA1; white rot.

Callistosporium luteoolivaceum (Berk. & M.A. Curtis) Singer- HA, KA, MO; ACKO, ACME1, ALNE; rot uncertain.

Calocera cornea (Batsch:Fr.) Fr.- OA; HDWD; brown rot.
Calocera furcata Fr.- OA; HDWD; brown rot.

Campanella aff. ***eberhardtii*** (Pat.) Singer- HA, KA, MA, MO; ACKO, HDWD, MAIN1, MEPO, PSCA; white rot.
Campanella alba (Berk. & M.A. Curtis) Singer- OA; PSGU; white rot.
Campanella junghuhnii (Mont.) Singer- OA; DOVI, PSGU; white rot.

Ceraceomyces sublaevis (Bres.) Jülich- KA; MEPO; white rot.

Ceriporia alachuana (Murrill) Hallenb.- HA; FIMI, MAIN1, SYCU; white rot.
Ceriporia excelsa (S. Lundell) Parmasto- HA; MEPO, MYSA1; white rot.
Ceriporia purpurea (Fr.) Donk- HA, KA, MO, OA; ACKO, ACME1, EUGL, EURO, HITI, MEPO, MYSA2, PEAM, PITA; white rot.
Ceriporia reticulata (Hoffm.:Fr.) Domański- HA, KA; ACKO, COMO, NESA, PSHA, SASA2; white rot.
Ceriporia viridans (Berk. & Broome) Donk- HA, KA, MO; ACME1, HDWD, HITI, PSGU, *Prunus*; white rot.
Ceriporia xylostromatoides (Berk.) Ryvarden & I. Johans.- HA, MA; ARHE, CAIN, CEOB, COMO, FIMI, HITI, PHNI, SASA2, SYJA; white rot.

Ceriporiopsis gilvescens (Bres.) Domański- KA; MEPO; white rot.
Ceriporiopsis mucida (Pers.:Fr.) Gilb. & Ryvarden- HA, MA; CUMA, TOCI; white rot.
Ceriporiopsis subrufa (Ell. & Dearn.) Ginns- HA, KA, MO; ACKO, ACME1, CAEQ, EUGL, MEPO; white rot.

Cerrena unicolor (Bull.:Fr.) Murrill- HA; ACKO, SASA2; white rot.

Chaetocalathus liliputianus (Mont.) Singer- HA, MA; HITI, PSCA; rot uncertain.

Chaetoporellus latitans (Bourdot. & Galzin) Bondartzev & Singer- HA; ACKO, CAIN, COMO, MEPO, NESA, SASA2; white rot.

Climacodon pulcherrimum (Berk. & M.A. Curtis) Nikol.- HA, KA; FIMI, PIEL; white rot.

Coltricia cinnamomea (Pers.) Murrill- HA; ACKO, MEPO; white rot.

Coniophora arida (Fr.) P. Karst.- HA, KA, MA, MO; ACME1, COWD, CRJA, CUMA, HDWD, MEPO, PIEL, PIRA, PITA; brown rot.
Coniophora hanoiensis Pat.- HA; CAEQ, EURO; brown rot.
Coniophora kauaiensis Gilb. & Hemmes- HA, KA; ACKO, ACME1, ACME2, CUMA, MYSA1, PIEL; brown rot.
Coniophora olivacea (Fr.:Fr.) P. Karst.- KA, MO; CUMA, EUGL, EUSA, PIEL; brown rot.
Coniophora puteana (Schum.:Fr.) P. Karst.- HA, KA; ACME2, CUMA, PIEL, SASA2; brown rot.

Coprinus lagopus (Fr.) Fr.- HA, OA; woodchips; rot uncertain.
Coprinus cinereus (Schaeff.:Fr.) Gray- HA, OA; woodchips; rot uncertain.
Coprinus curtus Kalchbr.- HA; woodchips; rot uncertain.
Coprinus disseminatus (Pers.:Fr.) Gray- HA; SASA1, TROR, woodchips; rot uncertain.
Coprinus micaceus (Bull.:Fr.) Fr.- KA; ACKO; rot uncertain.
Coprinus radians (Desm.) Fr.- HA; MYSA1, SASA1, TROR; rot uncertain.
Coprinus truncorum (Schaeff.) Fr.- HA; SASA2; rot uncertain.

Coriolopsis polygona (Pers.) Ryvarden- HA; HITI; white rot.

Coronicium thymicola (Bourdot & Galzin) Jülich- HA; ANEV, CICH, CIGL; white rot.

Corticium confusum Bourdot & Galzin- HA; MEPO; white rot.

Crepidotus alabamensis Murrill- HA, OA; ALMO, HITI, PSGU, SYJA; white rot.
Crepidotus amygdalosporus Kühner- OA; SYMA; white rot.
Crepidotus appalachianensis Hesler & A.H. Sm.- HA; *Pluchea*; white rot.
Crepidotus applanatus (Pers.) P. Kumm. var. ***globigera*** Berk.- OA; HITI; white rot.
Crepidotus avellaneus C.W. Sm.- OA; HDWD; white rot.
Crepidotus bakerae Ueki & C.W. Sm.- OA; MAIN1; white rot.
Crepidotus mollis (Fr.) Staude var. ***mollis*** - HA, OA; HITI, EPPI, SYJA, SYMA; white rot.
Crepidotus nephrodes (Berk. & M.A. Curtis) Sacc.- OA; PSGU; white rot.
Crepidotus roseus var. ***boninensis*** Hongo- HA, MA, OA; ACME1, EURO, SYCU; rot uncertain.
Crepidotus stromaticus (Cooke & Massee) Sacc.- HA, KA, OA; ACKO, COLA, HITI; rot uncertain.
Crepidotus uber (Berk. & M.A. Curtis) Sacc.- HA, MO, OA; EURO, HDWD, TROR; rot uncertain.

Crustoderma dryinum (Berk. & M.A. Curtis) Parmasto- HA; MEPO; brown rot.
Crustoderma gigacystidium Gilb. & Hemmes- HA; MYSA1; brown rot.

Crustomyces heteromorphum (Hallenb.) Hjortstam- HA; MAIN1; white rot.

Cryptotrama asprata (Berk.) Redhead & Ginns- HA, KA, MA, OA; ACKO, CAEQ, COLA, GRRO, MEPO, TECA, PSCA; white rot.

Cyphellopsis anomala (Pers.:Fr.) Donk- HA; ACKO, MYSA1; white rot.

Cystostereum murraii (Berk. & M.A. Curtis) Pouzar- HA, KA; ACKO, EUGL, MEPO, PECL, PSCA; white rot.

Dacrymyces deliquescens (Merat) Duby var. ***deliquescens***- HA, KA, MA; MEPO, SYJA; brown rot.
Dacrymyces deliquescens (Merat) Duby var. ***minor*** (Peck) Kennedy- MO; HDWD; brown rot.
Dacrymyces enatus (Berk. & M.A. Curtis) Massee var. ***macrospora*** Kennedy- MO; HDWD; white rot.

Dacryobolus sudans (Alb. & Schwein.:Fr.) Fr.- HA, KA, MO, OA; CRJA, CUMA, HITI; brown rot.

Dacryopinax spathularia (Schwein.) G.W. Martin- HA, KA, OA; ACKO, COWD, *Euphorbia*, HDWD, PRPA; brown rot.

Deflexula pacifica (Kobayasi) Corner- HA; ILAN; white rot.

Dendrophora albobadia (Schwein.:Fr.) Chamuris- HA, KA, MO; ACKO, ACME1, CAEQ, EUGL, EURO, MYSA1; white rot.
Dendrophora versiformis (Berk. & M.A. Curtis) Chamuris- KA; ACKO; white rot.

Dendrothele candida (Schwein.) Lemke- KA; HITI, MEPO; white rot.
Dendrothele incrustans (Lemke) Lemke- MO; CUMA; white rot.
Dendrothele microspora (H.S. Jacks. & Lemke) Lemke- HA; MEPO; white rot.
Dendrothele pachysterigmata (H.S. Jacks. & Lemke) Lemke- MA; PHNI; white rot.
Dendrothele strumosa (Fr.) Lemke- OA; PTMA; white rot.

Dichostereum pallescens (Schwein.) Boidin & Lanq.- HA, KA; ACKO, SASA2; white rot.

Diplomitoporus lindbladii (Berk.) Gilb. & Ryvarden- KA, MA, MO; *Eucalyptus*, PAFA, PIEL, PIPA; white rot.
Diplomitoporus overholtsii (Pilát) Gilb. & Ryvarden- MA; PIRA; white rot.

Ditiola radicata Alb. & Schwein.:Fr.- HA, OA; HDWD; brown rot.

Earliella scabrosa (Pers.) Gilb. & Ryvarden- HA, KA, MA, MO, OA; ACKO, ALMO, ARHE, CEOB, ERSA, FIMI, HDWD, HITI, MAIN1, PATE, PSGU, SCTE, TROR; white rot.

Entoloma fragilissimum E. Horak & Desjardin- HA; PATE, PSCA; rot uncertain.
Entoloma nanosordidum E. Horak & Desjardin- HA; PATE, PSCA; rot uncertain.
Entoloma purum E. Horak & Desjardin- HA; BAVU; rot uncertain.

Epithele hydnoides Burt- HA, OA; ACKO, CICH, CIGL; white rot.
Epithele nikau G. Cunn.- MA; ALPU, ETEL; white rot.
Epithele sulphurea Burt- HA; CHOB, COMO, NESA, SASA2, TROR; white rot.

Exidiopsis calcea (Pers.) K. Wells- HA; SYCU; white rot.
Exidiopsis fugacissima (Bourdot & Galzin) Sacc. & Trotter- HA, OA; ACKO, HDWD; white rot.
Exidiopsis molybdea (McGuire) Ervin- HA; ACKO, ALNE, COMO, NESA; white rot.
Exidiopsis mucidinea (Pat.) K. Wells- KA, MO; COLA, EURO; white rot.
Exidiopsis plumbescens (Burt) K. Wells- OA; HDWD; white rot.

Fibulomyces mutabilis (Bres.) Jülich- HA; CIGL; white rot.

Flavodon cervino-gilvus (Jungh.) Corner- HA, KA, MA, MO, OA; ALMO, CAEQ, CEOB, EURO, HITI, MEPO, PEAM, PSGU, SYJA, TROR; white rot.

Fomitopsis nivosa (Berk.) Gilb. & Ryvarden- HA; CONU, PEAM, PSGU, SYCU, TROR; brown rot.

Galerina atkinsoniana A.H. Sm.- HA, KA, MO; MEPO; rot uncertain.
Galerina decipiens A.H. Sm. & Singer- HA, KA, MA, MO; *Cibotium*, MEPO; rot uncertain.
Galerina nana (Petri) Kühner- HA, KA, MA, MO; ACKO, COLA, MEPO, PSCA; rot uncertain.
Galerina ohiarum E. Horak & Desjardin- HA; MEPO; rot uncertain.
Galerina physospora Singer- KA, MO; EURO, HITI; rot uncertain.
Galerina velutipes Singer- HA, KA, MA; CRJA, PATE, PSCA; white rot.

#*Ganoderma australe* (Fr.) Pat.- HA, KA, MO, OA; ACKO, CAEQ, CAIN, CONU, EUGL, MAIN1, PAFA, PIEL, SYMA, TROR; white rot.
#*Ganoderma lucidum* (W. Curtis:Fr.) P. Karst.- HA; MEPO; white rot.

Gloeocystidiellum clavuligerum (Höhn. & Litsch.) Nakasone- HA; ACKO; white rot.
Gloeocystidiellum lactescens (Berk.) Boidin- HA; ALMO, PAFA; white rot.
Gloeocystidiellum porosum (Berk. & M.A. Curtis) Donk- HA; ACKO, *Prunus*; white rot.

Gloeodontia discolor (Berk. & M.A. Curtis) Boidin- HA, MA; ALMO, ARHE, MEPO; white rot.

Gloeophyllum sepiarium (Fr.) P. Karst.- OA; PISI; brown rot.

Gloeophyllum striatum (Swartz:Fr.) Murrill- KA, LA, MO; ACME1, MYSA1, PIEL, PRPA; brown rot.
Gloeophyllum trabeum (Pers.:Fr.) Murrill- HA; MYSA1; brown rot.

Gloeoporus dichrous (Fr.) Bres.- HA, OA; COMO, CRJA, HDWD, MYSA1, SASA2; white rot.

Gloiocephala epiphylla Massee- HA, KA, MA; HITI, PSCA, on twigs; rot uncertain.

Grammothele fuligo (Berk. & Broome) Ryvarden- HA, OA; ARAL1, CONU, LICH, MAIN1, MESA, PATE, PRMA; white rot.

Grifola rosulata (G. Cunn.) G. Cunn.- HA; HDWD; white rot.

Gymnopilus subtropicus Hesler- HA, MO; CAEQ, CONU; rot uncertain.

Gymnopus luxurians (Peck) Murrill- HA, MO, OA; wood chips; rot uncertain.
Gymnopus subpruinosus (Murrill) Desjardin, Halling & Hemmes- HA, KA, MA; ACKO, COLA, MEPO, PITA; rot uncertain.

#Gyrodontium versicolor (Berk & Broome) Maas Geest.- KA, LA; ACKO, BAVU; brown rot.

Haplotrichum conspersum (Link) Hol.-Jech.- MA; PIEL; white rot.
Haplotrichum curtisii (Berk.) Hol.-Jech.- [anamorph of *Botryobasidium vagum* (Berk. & M.A. Curtis) D.P. Rogers & H.S. Jacks.] HA, KA, MA; ACKO, ARHE, EURO, HDWD, MEPO, MYLE, NESA, PIEL, SYCU; white rot.

Helicobasidium anomalum L. Olive- HA; SASA1; white rot.

Helicogloea lagerheimii Pat.- HA, OA; CICH, CIGL, *Eucalyptus*; white rot.

Heliocybe sulcata (Berk.) Redhead & Ginns- HA; MYSA1; brown rot.

Hemimycena tortuosa (Orton) Redhead- KA; CRJA; rot uncertain.

Henningsomyces candidus (Pers.:Fr.) Kuntze- HA, MA, MO; CAEQ, COMO, MOCI, MYSA1, PAFA, SYJA; white rot.
Henningsomyces separatus Gilb. & Hemmes- HA; MYSA1, SASA1; white rot.

Heterochaete delicata (Klotzsch ex Berk.) Bres.- MO, OA; ACME1, DERE; white rot.
Heterochaete gelatinosa (Berk. & M.A. Curtis) Pat.- HA; MEPO; white rot.
Heterochaete lividofusca Pat.- HA; INED; white rot.
Heterochaete microspora Burt- KA; HDWD; white rot.
Heterochaete mussooriensis Bodman- MO; CAEQ; white rot.

Heterochaete ogasawarsimensis S. Itô & S. Imai- OA; PIDU; white rot.
Heterochaete shearii (Burt) Burt- HA, KA; ACKO, COMO, HDWD, MYSA1, PIEL, PSHA, SASA2, SOCH; white rot.
Heterochaete verruculosa (F.H. Møller) Bodman- HA; CIGL, MEPO, TIUR, TOCI; white rot.

Hohenbuehelia approximans (Peck) Singer- HA; PRPA; white rot.
Hohenbuehelia atrocaerulea var. ***grisea*** (Peck) Thorn & G.L. Barron- HA, KA, MA; ACKO, COLA, MEPO, MYSA1, PIEL; white rot.

Hydropus semimarginellus Singer- HA; BAVU, CAEQ, CONU; rot uncertain.

Hygrocybe hapuuae Desjardin & Hemmes- HA; CIGL; rot uncertain.

Hymenochaete anomala Burt- MA; SYJA; white rot.
Hymenochaete corrugata (Fr.) Lév.- HA, MA; SASA2, SPCA; white rot.
Hymenochaete mougeotii (Fr.) Cooke- HA, KA; MEPO, TOCI; white rot.
Hymenochaete tomentelloidea Gilb. & Hemmes- HA; CICH; white rot.

Hyphoderma argillaceum (Bres.) Donk- HA, KA, OA; ACKO, ACME2, CAIN, CONU, CRJA, HDWD, INED, MEPO, NESA, PLAC, PSGU, SYJA; white rot.
Hyphoderma budingtonii Lindsey & Gilb.- HA; NESA; white rot.
Hyphoderma cremeoalbum (Höhn. & Litsch.) Jülich- MO; EURO; white rot.
Hyphoderma crystallophorum Gilb. & Adask.- MA; EURO, HITI, MAIN1; white rot.
Hyphoderma definitum (H.S. Jacks.) Donk- HA, KA; COMO, PIEL; white rot.
Hyphoderma medioburiense (Burt) Donk- KA; MEPO; white rot.
Hyphoderma naiophila Gilb. & Hemmes- HA; MYSA1; white rot.
Hyphoderma nudicephalum Gilb. & M. Blackw.- HA, KA, MA, OA; CAEQ, *Cibotium*, EURO, FRUH, MAIN1, MEUM, PIEL, PHNI, PSGU, SYCU, SYJA, TIUR, TOCI, TROR; white rot.
Hyphoderma pallidum (Bres.) Donk- HA, KA, MA, MO; ACKO, COMO, CUMA, EURO, MEPO, MYSA1, NESA, PIBR, PIEL, PIPI, PITA, SASA2, SYJA; white rot.
Hyphoderma praetermissum (P. Karst.) J. Erikss. & Å. Strid- HA, KA, MA, MO, OA; ACKO, ALMO, CAEQ, CAIN, COMO, ERSA, EURO, HITI, MAIN1, MEPO, MEUM, MYSA1, NESA, PAFA, PECL, PHNI, PIAL, PIEL, PIPA, PIPI, PSGU, PSHA, PSME, SASA2, SCAC, SCGL, SOCH, SPCA, SYJA, TOCI, TROR; white rot.
Hyphoderma puberum (Fr.) Wallr.- HA, KA, MA; ACKO, EURO, HDWD, MAIN1, PIPA, PIPI, PSCA; white rot.
Hyphoderma sambuci (Pers.) Jülich- HA, KA, MA; ACKO, CAEQ, CICH, COMO, CRJA, CUMA, ERSA, EURO, HITI, INED, MEPO, MUPA, MYSA1, MYSA2, PAFA, PHNI, PIAL, PIEL, PIPI, PIRA, SASA2, SCGL, SOCH; white rot.
Hyphoderma setigerum (Fr.) Donk- HA, KA, MO; ACKO, CRJA, ERSA, EURO, PIEL; white rot.

Hyphoderma sphaeropedunculatum Gilb. & Hemmes- HA; DOVI, MYSA1; white rot.
Hyphoderma subdefinitum J. Erikss. & Å. Strid- KA; PIEL; white rot.
Hyphoderma vulcanense Gilb. & Adask.- HA; ACKO, CAIN, CAEQ, CEOB, COMO, FRUH, GRRO, MAIN1, MEPO, MEUM, PSCA, PSGU, TECA, TIUR, TROR; white rot.

Hyphodermella maunakeaensis Gilb. & Hemmes- HA; COMO, MYSA1; white rot.

Hyphodontia aloha Gilb. & Adask.- HA, MA, MO; CUMA, HITI, MYSA1, PIPI; white rot.
Hyphodontia alutaria (Burt) J. Erikss.- HA; ACKO, *Cibotium*, DOVI, MYSA1, PAFA; white rot.
Hyphodontia arguta (Fr.) J. Erikss.- HA, MA, MO; ACKO, COMO, CRJA, CUMA, EURO, HITI, MEPO, MEUM, MYSA1, PAFA, PIAL, PIRA, PISA, *Prunus*, PSCA, SASA2, SOCH, TROR; white rot.
Hyphodontia breviseta (P. Karst.) J. Erikss.- HA, KA, MA; ACKO, CUMA, DOVI, ETEL, MYSA1, HITI, PHNI, PIPI, SCGL; white rot.
Hyphodontia crustosa (Pers.:Fr.) J. Erikss.- HA, MA; ACKO, CUMA, MEPO, MYSA1; white rot.
Hyphodontia granulosa (Pers.:Fr.) Ginns & Lefebvre- HA, MA; ACKO, CUMA, MEPO, PHNI, SCGL; white rot.
Hyphodontia hastata (Litsch.) J. Erikss.- HA; PSME; white rot.
Hyphodontia microspora J. Erikss. & Hjortstam- HA, KA, MA; CUMA, HDWD, HITI, MEPO, PIEL, PSCA, PIPI, SESE; white rot.
Hyphodontia nespori (Bres.) J. Erikss. & Hjortstam- HA, KA, MA; ACKO, CAIN, COMO, CUMA, EURO, MEPO, PIEL, PSHA, SESE, SYJA; white rot.
Hyphodontia pallidula (Bres.) J. Erikss.- HA, KA, MA, MO, OA; ACKO, ACME1, CAEQ, CAIN, MEPO, PIEL, PIPI; white rot.
Hyphodontia pruni (Lasch) J. Erikss. & Hjortstam- HA; ACKO, MEPO; white rot.
Hyphodontia rimosissima (Peck) Gilb.- HA, MO; ARHE, MEPO; white rot.
Hyphodontia spathulata (Schrad.:Fr.) Parmasto- HA, MO; ARHE, MYSA1; white rot.
Hyphodontia verruculosa J. Erikks. & Hjortstam- MO; ARHE, MEPO; white rot.

Hypholoma fasciculare (Huds.:Fr.) P. Kumm.- MA; woodchips; rot uncertain.

Hypochnicium eichleri (Bres.) J. Erikss. & Ryvarden- KA; EURO; white rot.
Hypochnicium lundellii (Bourdot) J. Erikss.- HA, KA, MO; ACKO, CAEQ, CUMA, PIEL, SYMA; white rot.
Hypochnicium punctulatum (Cooke) J. Erikss.- HA, MA; CICH, EUGL, SYJA; white rot.
Hypochnicium sphaerosporum (Höhn. & Litsch.) J. Erikss.- KA; ACKO; white rot.

Incrustocalyptella hapuuae Desjardin- HA; CIGL; rot uncertain.

Irpex griseo-fuscescens (Reichardt) D.A. Reid- HA; ACKO, PAFA, TROR; white rot.

Junghuhnia nitida (Fr.) Ryvarden- OA; HDWD, PSGU; white rot.

Lachnella alboviolescens (Alb. & Schwein.:Fr.) Fr.- HA; PIAL; white rot.
Lachnella conferta Gilb. & Adask.- MA; SYJA; white rot.

Lactocollybia epia (Berk. & Broome) Pegler- HA; CAEQ, SASA1; rot uncertain.

#*Laetiporus sulphureus* (Bull.:Fr.) Murrill- HA, KA, MO, OA; ACKO, CACU, EUGL, FIMI; brown rot.

Lentinus bertieri (Fr.) Fr.- HA, MA, OA; HDWD, SYJA, TROR; white rot.
Lentinus ciliatus Lév.- HA, KA, MA, MO, OA; ALMO, HDWD, MAIN1, MEUM, TROR; white rot.

Lepiota besseyi H.V. Sm. & N.S. Weber- HA, OA; woodchips; rot uncertain.

Leptosporomyces ovoideus Jülich- HA, MA; HEFL, HITI, SYJA; white rot.
Leptosporomyces roseus Jülich- HA; ERSA; white rot.

Leucogyrophana mollusca (Fr.) Pouzar- HA, KA; CUMA, MAIN1, MEPO; brown rot.
Leucogyrophana olivascens (Berk. & M.A. Curtis) Ginns & Weresub- KA; PIEL; brown rot.

Marasmiellus pacificus Desjardin- HA, KA; ALPU, TROR; rot uncertain.
Marasmiellus palmivorus Sharples- HA; ALPU, CONU, ETEL; rot uncertain.

Marasmius pseudobambusinus var. *hawaiiensis* Desjardin- HA; HECO; rot uncertain.
Marasmius radiatus Desjardin- HA; CAEQ, SASA1, SPCA; rot uncertain.

Megasporoporia cavernulosa (Berk.) Ryvarden- HA, KA, MA; CAEQ, CEOB, ERSA, EURO, HDWD, HITI, PSCA, PSGU, TROR; white rot.

Meruliopsis corium (Pers.:Fr.) Ginns- KA, OA; ACKO; white rot.

Microporus flabelliformis (Klotzsch) Kuntze- HA, MA, MO, OA; ALMO, CAEQ, EURO, HDWD, HITI, MAIN1, MEPO, PEAM, SCAC, TECA, TOCI; white rot.

Mucronella aggregata Fr.- MA; PIEL; white rot.

Mycena adscendens (Lasch) Maas Geest.- HA, KA; ACKO, CIGL, MEPO; rot uncertain.
Mycena alphitophora (Berk.) Sacc.- HA, MA, MO, OA; ALMO, CAEQ, FLBR, HDWD, MAIN1, PAFA, PSCA, SASA1, SYCU; rot uncertain.
Mycena discogena Singer- HA; PSCA; rot uncertain.

Mycena hawaiiensis Desjardin- HA, KA, OA; ARAL1, HDWD, PAFA; rot uncertain.
Mycena papyracea Desjardin & Hemmes- MO; ACCO, CAEQ, EURO; rot uncertain.
Mycena sotae Singer- HA, MO; SASA1; rot uncertain.
Mycena spinosissima (Singer) Desjardin- HA, MA, MO; CAEQ, HDWD, PAFA, PSCA, SCTE; rot uncertain.

Mycoacia aurea (Fr.) J. Erikss. & Ryvarden- MA; EURO; white rot.
Mycoacia kurilensis Parmasto- HA; COMO, FRUH, HDWD, HITI, MEUM, MEPO, NESA, PEAM, TOCI; white rot.

Nigroporus vinosus (Berk.) Murrill- HA, KA, MA, MO; ACKO, ALPU, CAEQ, CUMA, GRRO, MEPO, PIEL; white rot.

#Oligoporus balsameus (Peck) Gilb. & Ryvarden- MO; CUMA; brown rot.
Oligoporus caesius (Schrad.:Fr.) Gilb. & Ryvarden- MA, MO; ACME1, ARHE, CUMA, EURO; brown rot.
Oligoporus floriformis (Quél.) Gilb. & Ryvarden- MA; CUMA, PIEL, PIPI; brown rot.
Oligoporus fragilis (Fr.) Gilb. & Ryvarden- MA; PIRA; brown rot.
Oligoporus perdelicatus (Murrill) Gilb. & Ryvarden- HA; COMO, PIRA; brown rot.
Oligoporus placentus (Fr.) Gilb. & Ryvarden- MA; PIPI; brown rot.
Oligoporus stipticus (Pers:Fr.) Gilb. & Ryvarden- HA, KA, MA, MO; ACKO, ACME1, CUMA, HDWD, MEPO, MYSA1, PIEL, PIPI, PIRA; brown rot.
Oligoporus undosus (Peck) Gilb. & Ryvarden- MA; PIRA; brown rot.

Oxyporus corticola (Fr.) Ryvarden- HA; HDWD; white rot.
Oxyporus latemarginatus (Durieu & Mont.:Mont.) Donk- OA; CLAR; white rot.
Oxyporus similis (Bres.) Ryvarden- HA; ERSA; white rot.

Parmastomyces transmutans (Overh.) Gilb. & Ryvarden- KA, MA; ACME1, ACME2, CUMA, EUGL, PIEL, PIPI, PIRA; brown rot.

Parvobasidium cretatum (Bourdot & Galzin) Jülich- HA; HITI, TEST; white rot.

Paxillus curtisii Berk.- HA, KA, MA, MO, OA; CAEQ, EURO, HDWD, LOCO, MEPO, PIEL; brown rot.
Paxillus panuoides (Fr.:Fr.) Fr.- HA, KA, MA; EURO, MEPO, PIEL, PIPI, PIRA; brown rot.

Peniophora cinerea (Pers.:Fr.) Cooke- HA, KA, MA; ACKO, CAEQ, EUGL, INED, MEPO, MYSA1, SCGL, SYJA; white rot.
Peniophora crustosa Cooke- HA, KA; MEPO, MYSA1; white rot.
Peniophora incarnata (Pers.:Fr.) P. Karst.- HA, KA, OA; ARAL2, COMO, MAIN1, MEPO, MYSA1; white rot.
Peniophora lycii (Pers.) Höhn. & Litsch.- HA, KA; ERSA, PIEL; white rot.
Peniophora nuda (Fr.) Bres.- HA; MYSA1; white rot.

Peniophora pithya (Pers.) J. Erikss.- KA; PIEL; white rot.
Peniophora scintillans G. Cunn.- HA; TOCI; white rot.

Perenniporia japonica (Yasuda) Hattori & Ryvarden- HA, MO; CACU, EUGL; white rot.
#Perenniporia subacida (Peck) Donk- KA; PIEL; white rot.
Perenniporia tephropora (Mont.) Ryvarden- HA, KA, MA, MO, OA; ACKO, ACME1, ALMO, ARHE, CACU, CAEQ, EUGL, EURO, GRRO, MAIN1, MEAZ, MEPO, PAFA, PRPA, SYCU, TOCI; white rot.

#Phaeolus schweinitzii (Fr.) Pat.- HA, MA; ACKO, PIEL; brown rot.

Phanerochaete aculeata Hallenb.- HA, KA; MYSA1, PIEL; white rot.
Phanerochaete arizonica Burds. & Gilb.- HA; ACKO, ERSA, MEPO; white rot.
Phanerochaete australis Jülich- HA, KA, MA, MO, OA; ACKO, CAEQ, EURO, HDWD, HITI, MAIN1, MEPO, MEUM, PAFA, PEAM, PIEL, PSCA, PSGU, PSHA, SYCU, SYJA, TROR; white rot.
Phanerochaete avellanea (Bres.) J. Erikss. & Hjortstam- HA, KA; ACKO, CAEQ, MEPO; white rot.
Phanerochaete chrysorhiza (Torr.) Budington & Gilb.- HA; HITI; white rot.
Phanerochaete crescentispora Gilb. & Hemmes- HA; MYSA1; white rot.
Phanerochaete eburnea Sheng H. Wu- HA, KA; ACME2, CAEQ, CEOB, HITI; white rot.
Phanerochaete hiulca (Burt) A.L. Weldon- KA; ACME1, ACME2; white rot.
Phanerochaete jose-ferreirae (D.A. Reid) D.A. Reid- HA; TECA; white rot.
Phanerochaete magnoliae (Berk. & M.A. Curtis) Burds.- HA; SASA2; white rot.
Phanerochaete mauiensis Gilb. & Adask.- HA, MA, OA; ACKO, CEOB, *Euphorbia*, FRUH, HITI, MEPO, MEUM, MOCI, PAFA, PISA, PSGU, SCTE, SYJA, THPO, TROR; white rot.
Phanerochaete sordida (P. Karst.) J. Erikss. & Ryvarden- HA; ACKO, EUGL, HITI, MEPO, MYSA1, PSGU, TROR; white rot.
Phanerochaete suballantoidea Sheng H. Wu- HA; COMO, MEPO; white rot.

Phellinus contiguus (Fr.) Pat.- OA; *Cibotium*; white rot.
Phellinus fastuosus (Lév.) Ryvarden- KA; ACKO; white rot.
Phellinus ferruginosus (Schrad.:Fr.) Bourdot & Galzin- HA, MA; MEPO, NESA; white rot.
Phellinus gilvus (Schwein.) Pat.- HA, KA, MA, MO, OA; ACKO, ACME1, ALMO, CAEQ, EUGL, EURO, FIMI, GRRO, HDWD, MAIN1, MEPO, NESA, PAFA, PEAM, PIDU, PIEL, PSCA, PSGU, SASA1, SASA2, TROR; white rot.
#Phellinus grenadensis (Murrill) Ryvarden- HA, OA; ACKO, CAEQ, EUGL, *Eucalyptus*, DIHI, MEAZ, MEPO, PEAM, PSHA, TOCI; white rot.
#Phellinus kawakamii M.J. Larsen, Lombard, & Hodges- HA; CAEQ; white rot.
Phellinus melleoporus (Murr.) Ryvarden- HA, MA; DOVI, PSGU; white rot.
#Phellinus robustus (P. Karst.) Bourdot & Galzin- HA, KA; MEPO, MYSA1, SASA2,

STTA; white rot.
Phellinus rufitinctus (Cooke) Pat.- MA; HITI; white rot.
Phellinus wahlbergii (Fr.) D.A. Reid- HA; ACKO, MEPO; white rot.

Phlebia acanthocystis Gilb. & Nakasone- HA, KA, MA, OA; ACKO, ACME2, CAEQ, CAIN, COMO, EUGL, FRUH, HITI, MAIN1, MEPO, MEUM, MOCI, MYSA2, NESA, PATE, PEAM, PSCA, PSGU, SASA1, SASA2, SCAC, SYCU, SYJA, TEST, TOCI, TROR; white rot.
Phlebia acerina Peck- HA; PIAL; white rot.
Phlebia coccineofulva Schwein.- MA; SYJA; white rot.
Phlebia hydnoidea Schwein.- HA, KA, MO; EURO, MEPO; white rot.
Phlebia lilascens (Bourdot) J. Erikks & Hjörtstam- HA, KA; MYSA1; white rot.
Phlebia livida (Pers.:Fr.) Bres.- KA; ACME1, ACME2, MEPO; white rot.
Phlebia subfascicularis (Wakef.) Nakasone & Gilb.- OA; FIMI; white rot.
Phlebia tremellosa (Schrad.:Fr.) Nakasone & Burds.- HA, KA, MA, MO; HDWD, MEPO, PIEL, PIPA, PIRA; white rot.

Phlebiella fibrillosa (Hallenb.) K. H. Larss. & Hjortstam- HA; MYSA1; white rot.
Phlebiella subflavidogrisea (Litsch.) Oberw.- KA, MA; ARHE, MEPO; white rot.
Phlebiella tulasnelloidea (Höhn. & Litsch.) Ginns & LeFebvre- HA, KA, MA, MO, OA; ACKO, ACME1, ACME2, ALMO, ARHE, CAEQ, CICH, COMO, CRJA, CUMA, EUGL, EURO, FIMI, FRUH, GRRO, HDWD, HITI, INED, MAIN1, MEPO, MYLE, MYSA1, NESA, PAFA, PEAM, PECL, PHNI, PIEL, PIPA, PIRA, PSCA, PSME, SASA1, SASA2, SYJA, TIUR, TOCI, TROR; white rot.

Phlebiopsis flavido-alba (Cooke) Hjortstam- HA, KA, MA; ACKO, MAMA, MEPO, PRPA; white rot.
Phlebiopsis peniophoroides Gilb. & Adask.- HA, KA, MA, MO; ACKO, ACME1, ACME2, EUGL, EURO, FIMI, HDWD, HITI, MEPO, MEUM, MYLE, *Prunus*, PSCA, PSGU, PSHA, SPCA, SYJA, TOCI, TROR; white rot.
Phlebiopsis ravenelii (Cooke) Hjortstam- HA; SYJA; white rot.

Pholiota peleae E. Horak & Desjardin- HA, KA, MA, MO; CIGL, MEPO, MYLE, PSHA; white rot.

Physisporinus sanguinolentus (Alb. & Schwein.:Fr.) Pilát- OA; FIMI; white rot.
Physisporinus vitreus (Pers.:Fr.) P. Karst.- HA, MA; ALNE, CONU, HITI, PAFA; white rot.

Piloderma byssinum (P. Karst.) Jülich var. *byssinum*- HA, MO; ACKO, EURO; white rot.

Pleuroflammula flammea (Murrill) Singer- HA, KA, MA; CLAR, HITI, MEPO, MYLE, PSHA; rot uncertain.

#Pleurotus cystidiosus O.K. Mill.- HA, KA, MA; ACKO, PSGU; white rot.
Pleurotus djamor (Fr.) Boedijn- HA, KA; ACKO, CONU, MEPO; white rot.
#Pleurotus ostreatus (Jacq.:Fr.) P. Kumm.- HA; ACKO; white rot.

Polyporus arcularius Batsch.:Fr.- HA, KA, MA, MO, OA; CAEQ, CEOB, COMO, EUGL, EURO, HDWD, HITI, MEPO, *Prunus*, SESE, SYJA, TROR; white rot.
Polyporus tricholoma Mont.- KA; MEPO; white rot.

Psathyrella fuscofolia (Peck) A.H. Sm.- KA; ACKO, ACME1, MEPO; rot uncertain.
Psathyrella hydrophila (Bull.:Fr.) Maire- KA; ACKO; rot uncertain.
Psathyrella aff. *singeri* A.H. Sm.- HA; CAEQ, CONU; rot uncertain.

Pulveroboletus xylophilus (Petch) Pegler- HA; CONU; rot uncertain.

Pycnoporus cinnabarinus (Jacq.:Fr.) P. Karst.- HA, KA; CONU, PAFA, PIEL; white rot.
Pycnoporus sanguineus (L.:Fr.) Murrill- HA, KA, MA, MO, OA; ACKO, ARHE, CAEQ, MAIN2, PAFA, PIEL, SYJA, TROR; white rot.

Pyrrhoglossum pyrrhum (Berk. & M.A. Curtis) Singer- KA; MEPO; rot uncertain.

Radulomyces kama`aina Gilb. & Hemmes- HA; MYSA1; white rot.
Radulomyces poni Gilb. & Hemmes- HA; MYSA1; white rot.

Resinicium bicolor (Alb. & Schwein.:Fr.) Parmasto- HA, KA, MA, MO; ACKO, ACME2, ALNE, ARHE, CAEQ, CEOB, CICH, CRJA, CUMA, EUGL, EURO, GRRO, *Heliconia*, HITI, MEPO, PIEL, PIPA, PIPI, PSGU, PSCA, PSHA, SASA2, SCGL, TIUR, TOCI, TROR; white rot.
Resinicium saccharicola (Burt) Nakasone- OA; SAOF; white rot.

Resupinatus applicatus (Batsch:Fr.) Gray- HA, KA, MO; COLA, EUGL, TROR; white rot.
Resupinatus striatulus (Pers.:Fr.) Murrill- HA; MYSA1; white rot.

Rhodocollybia laulaha Desjardin, Halling & Hemmes- HA, KA, MA; ACKO, *Cibotium*, FRUH, MEPO, MYLE, PSHA; rot uncertain.

Rigidiporus lineatus (Pers.) Ryvarden- HA, OA; ALMO, GRRO, MAIN1, TROR; white rot.
Rigidiporus microporus (Fr.) Overeem- HA, LA, MA, OA; ACKO, ALMO, ARAL2, CONU, EURO, FIMI, HDWD, MAIN1, MUPA, PEAM, SASA1, PSGU, TROR; white rot.
#Rigidiporus ulmarius (Sowerby:Fr.) Imazeki- HA; MEAZ, MEPO, PSHA; white rot.
Rigidiporus undatus (Pers.:Fr.) Donk- HA, OA; ALNE, CAEQ, COMO, CONU, GRRO, HDWD, MAIN1, MEPO, PSGU, PSHA, SASA1, SCAC, TOCI; white

rot.

Rigidiporus vinctus (Berk.) Ryvarden- HA, KA, MA, MO, OA; ACKO, ALMO, ARAL2, CAEQ, EUGL, on *Phellinus gilvus* (Schw.) Pat. on *Eucalyptus*, HDWD, GRRO, HITI, MAGL, MAIN1, MEUM, MOCI, NESA, PAFA, palm, SASA1, PSGU, SCAC, SYJA, TROR; white rot.

Schizophyllum commune Fr.- HA, KA, MA, OA; ACKO, ACME1, ARHE, HDWD, MEPO, PAFA, PIEL, SAOF; white rot.

Schizopora flavipora (Cooke) Ryvarden- HA, KA, MA, MO, OA; ACKO, ACME2, ALNE, CAEQ, CICH, CUMA, EUGL, EURO, GRRO, HDWD, HITI, MAIN1, MEPO, MOCI, PIAL, PIEL, PITA, PSGU, SCGL; white rot.

Schizopora paradoxa (Schrad.:Fr.) Donk- HA, KA, MA; ACKO, MEPO, SCGL; white rot.

Schizopora radula (Pers.:Fr.) Hallenb.- HA, KA; MEPO, PIEL; white rot.

Scopuloides rimosa (Cooke) Jülich- HA, MA, OA; ACKO, CEOB, EUGL, FIMI, FRUH, HITI, HDWD, INED, MAIN1, MEPO, MEUM, PSCA, PSHA, SASA2, SPCA, SYCU, SYMA, TECA, TEST, TOCI, TROR; white rot.

Scytinostroma duriusculum (Berk. & Broome) Donk- HA, MA; INED, MAIN1; white rot.

Scytinostroma galactinum (Fr.) Donk- HA, MA, OA; ACKO, COMO, CONU, CRJA, FIMI, LELE, NESA, PIPI, PSGU, SASA1; white rot.

Scytinostroma hemidichophyticum Pouzar- HA, MO; CAEQ, CIGL; white rot.

Scytinostroma ochroleucum (Bres. & Torrend) Donk- HA, KA, MO; CRJA, PIPA, PITA; white rot.

Scytinostroma portentosum (Berk. & M.A. Curtis) Donk- HA, MA; ACKO, ALMO, INED; white rot.

Sebacina epigaea (Berk. & Broome) Neuhoff var. ***epigaea***- HA; ALNE; white rot.

Sebacina incrustans (Pers.:Fr.) Tul.- MO; EURO; white rot.

Sebacina opalea Bourdot & Galzin- HA; CAEQ, PHNI, TECA; white rot.

Sebacina podlachica Bres.- HA; SYMA; white rot.

Serpula himantioides (Fr.:Fr.) P. Karst.- HA; ACKO; brown rot.

Serpula incrassata (Berk. & M.A. Curtis) Donk- HA, KA, MA; ACKO, COMO, CUMA, FRUH, PIEL, PITA; brown rot.

Sirobasidium sandwicense Gilb. & Adask.- HA; TROR; rot uncertain.

Sistotrema brinkmannii (Bres.) J. Erikss.- OA; *Cibotium*, HDWD, *Pritchardia*; white rot.

Sistotrema subtrigonospermum D.P. Rogers- OA; HDWD; white rot.

Sistotremastrum niveocremeum (Höhn. & Litsch.) J. Erikss.- KA; HDWD; white rot.

Skeletocutis lenis (P. Karst.) Niemelä- HA, KA; HDWD, NESA; white rot.
Skeletocutis lilacina A. David & Jean Keller- HA, KA, MA, MO, OA; ACKO, ACME1, ARHE, CULA, CUMA, EUGL, EURO, MEPO, PIEL, *Prunus*, PSGU; white rot.

Steccherinum ochraceum (Pers.:Fr.) Gray- HA, MO; CAEQ, PSCA, PSGU; white rot.
Steccherinum rawakense (Pers.) Banker- HA, OA; ACKO, SYCU; white rot.

Stereum hirsutum (Willd.:Fr.) Gray- HA, KA, MO; ACKO, ACME1, EURO, SYCU; white rot.
Stereum illudens Berk.- MO; ARHE; white rot.
Stereum ostrea (Blume & Nees:Fr.) Fr.- MO, OA; EUGL, EURO; white rot.
#*Stereum sanguinolentum* (Alb. & Schwein.:Fr.) Fr.- MA; PIEL, PIPI; white rot.

Stropharia variicolor Desjardin & Hemmes- HA; woodchips; rot uncertain.

Subulicystidium cochleum Punugu- HA; ERSA; white rot.
Subulicystidium longisporum (Pat.) Parmasto- HA, KA, MA, MO, OA; ALMO, ARAL1, CAEQ, CEOB, COMO, CONU, EUGL, FIMI, FRUH, HDWD, HITI, LICH, MAIN1, MEPO, MEUM, MOCI, NESA, PATE, PIBR, *Pritchardia*, PSCA, PSGU, PSHA, SASA1, SASA2, SCAC, SCTE, SYJA, TECA, TOCI, TROR; white rot.

Tetrapyrgos nigripes (Schwein.) E. Horak- HA, KA, MO, OA; CAEQ, HDWD; rot uncertain.

Thelephora terrestris Ehrenb.:Fr.- KA; PIEL; rot uncertain.

Tinctoporellus epimiltinus (Berk. & Broome) Ryvarden- HA, MA, OA; ARHE, CAEQ, EUGL, EURO, FRUH, HDWD, MEPO, PSGU, PSHA, SYJA, TOCI, TROR; white rot with streaks of red discoloration.

Tomentella chlorina (Massee) G. Cunn.- HA, KA, MO, OA; ACKO, ALMO, CAEQ, CUMA, EURO, HDWD, MAIN1, MEPO, MYSA1, PSCA, SYJA; rot uncertain.

Trametes cervina (Wulfen:Fr.) Pilát- HA, KA; HITI, MEUM, PIRA, SYCU; white rot.
Trametes hirsuta (Wulfen:Fr.) Pilát- HA, KA, OA; ACKO, ACME1, CYSC, HDWD, ERSA, EUGL, MAIN1, MEPO, MYSA1, PIEL, SASA2; white rot.
Trametes versicolor (L.:Fr.) Pilát- HA, KA, MA, OA; ACKO, ACME1, EUGL, FRUH, HDWD, MEPO, MYSA1, NESA, PIRA, PSGU; white rot.

Trechispora alnicola (Bourdot & Galzin) Liberta- HA, MO; CAEQ, PATE; white rot.
Trechispora byssinella (Bourdot) Liberta- HA; MEPO; white rot.

Trechispora clanculare (Park.-Rhodes) K.H. Larss.- KA; ACME1; white rot.
Trechispora farinacea (Pers.:Fr.) Liberta- HA, MA, MO, OA; ACME1, ANPL, ARHE, CAEQ, CAIN, CICH, CIGL, COMO, CONU, GRRO, HDWD, HITI, INED, MEPO, NESA, PHNI, PIBR, PIEL, PIPI, SASA2, SCGL, SYJA, TECA; white rot.
Trechispora lunata (Romell) Jülich- HA, KA; ACME2, CRJA, MEPO, MYFA; white rot.
Trechispora microspora (P. Karst.) Liberta- HA; TOCI; white rot.
Trechispora mollusca (Pers.:Fr.) Liberta- KA, MO; ACKO, ACME1, EURO; white rot.
Trechispora stellulata (Bourdot & Galzin) Liberta- HA; MEPO; white rot.

Tremella boraborensis L. Olive- HA, MO, OA; ALMO, SASA1; white rot.
Tremella foliacea Pers.:Fr.- HA, KA, MO, OA; ACKO, TROR; white rot.
Tremella fuciformis Berk.- HA, KA, OA; ACKO, ALMO, CAEQ, HDWD, PAFA, SASA1; white rot.
Tremella mesenterica Retz.:Fr.- HA, OA; ACKO, MEPO; white rot.

Tricholomopsis rutilans (Schaeff. ex Fr.) Singer- MO; CUMA; white rot.

Tubulicium dussii (Pat.) Jülich- HA, MA, OA; CICH, CIGL, PHNI; white rot.
Tubulicium vermiferum (Bourdot) Jülich- HA, OA; ACKO, CONU, EURO, HDWD, MEPO, PHNI; white rot.

Tubulicrinis accedens (Bourdot & Galzin) Donk- HA; ACKO; white rot.
Tubulicrinis calothrix (Pat.) Donk- HA, KA, LA, MA, MO, OA; ACKO, COWD, CUMA, EUGL, EURO, HDWD, MYSA1, MEPO, PIEL, PIPI, PIRA; white rot.
Tubulicrinis gracillimus (D.P. Rogers & H.S. Jacks.) G. Cunn.- HA; MYSA1; white rot.
Tubulicrinis subulatus (Bourdot & Galzin) Donk- HA; MYSA1, PIRA; white rot.

Tulasnella calospora (Boud.) Juel- OA; CICH; white rot.
Tulasnella pinicola Bres.- OA; CONU; white rot.

Tyromyces subgiganteus (Berk. & M.A. Curtis) Ryvarden- HA; MEPO; white rot.

Vararia gomezii Boidin & Lanq.- HA; ERSA, PSGU, TROR; white rot.
Vararia microhyphidia Gilb. & Hemmes- HA; CICH; white rot.

Vesiculomyces epitheloides Boidin, Lanq. & Gilles- HA, MA, MO, OA; ACKO, ALMO, CAEQ, CAIN, CEOB, COMO, CONU, CUMA, EUGL, *Euphorbia*, FIMI, FRUH, GRRO, HDWD, HITI, INED, MAIN1, MEPO, MEUM, PATE, PSCA, PSGU, PSHA, SASA1, SASA2, SCAC, SYCU, SYJA, TEST, TROR; white rot.

Volvariella bombycina (Schaeff.:Fr.) Singer var. *ciliatomarginata* Desjardin & Hemmes-

LA; ARHE; white rot.

Volvariella volvacea (Bull.:Fr.) Singer- HA, KA; woodchips; white rot.

Xenasma rimicola (P. Karst.) Donk- MA; SYJA; white rot.

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TAXONOMY OF THE RUSSULA XERAMPELINA GROUP. PART 2. TAXONOMIC AND NOMENCLATURAL STUDY OF RUSSULA XERAMPELINA AND R. ERYTHROPODA

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Abstract

Four taxa of *Russula* sect. *Xerampelinae* with purple, purple-brown or red brown pileus cuticle associated with coniferous trees occurring in Europe are accepted: *Russula amoenipes*, *R. xerampelina* var. *xerampelina*, *R. xerampelina* var. *tenuicarnosa* and *R. favrei*. Circumscription of *R. xerampelina*, the species considered in recent literature as synonymous with *R. erythropoda*, as in the original description, suggests that its fits better with *R. favrei* than with *R. erythropoda*. In order to avoid disadvantageous changes in the nomenclature a neotype is proposed for *R. xerampelina*. A neotype is designated for *R. erythropoda*. The new variety, *R. xerampelina* var. *tenuicarnosa*, is described. A key and detailed descriptions of observed taxa are given. *R. atrosanguinea* is treated as synonym of *R. xerampelina* and other not validly published or misapplied names are listed. The taxonomy and nomenclature of *R. xerampelina*, *R. erythropoda*, *R. amoenipes*, *R. favrei* and other names of related or similar taxa are discussed.

Key words: *Russula xerampelina* var. *tenuicarnosa*, *R. amoenipes*, *R. favrei*, *R. atrosanguinea*, taxonomy, nomenclature, Slovakia

Introduction

The first part of this study (ADAMČÍK & MARHOLD 2000) included a morphometric study of fruitbodies of the *Russula xerampelina* group with a purple, purple-brown or red brown pileus cuticle associated with coniferous trees from selected localities in Slovakia. According to the results of multivariate analyses, the studied fruitbodies consist of three groups. The first group of fruitbodies with purple-brown or red-brown pileus cuticle (group A) was suggested to be classified as species, and the other two groups with purple pileus cuticle (group B) as varieties of another species. Based on these morphometric studies, this second part of the study includes taxonomic accounts of *R. favrei*, *R. erythropoda*, *R. xerampelina*, as well as *R. amoenipes*, a further species of the group occurring in Europe. Relationships with related taxa occurring in other parts of Europe as well as most important synonyms are discussed.

Taxonomic and nomenclatural notes

The first validly published name in *Russula* sect. *Xerampelinae* is *Agaricus xerampelinus* Schaeff. (Schaeffer 1774). Schaeffer described the colour of the pileus cuticle of *A. xerampelinus* as "fusco-purpureus"[1] (for complete original diagnosis see Tab. 1), which corresponds well with the group of fruitbodies with purple-brown or red-brown pileus cuticle, labelled as group "A" after a multivariate analyses (Adamčík & Marhold 2000). Another character of *A. xerampelinus* similar to this group of fruitbodies from Slovakia and different from the other two groups in the multivariate analyses (with purple pileus cuticle, which were labelled as "B"), is a contrast of coloration of pileus cuticle on the margin and in the centre. Schaeffer (1774) added to his original description of *A. xerampelinus* his figures "Tab. CCXIV, CCXV" (Schaeffer 1771; for black and white copy of pl. 214 see Fig. 1.), which presents a distinctly darker colour of the cuticle on the margin than in the centre of pileus. No fruitbody of the groups with purple pileus cuticle (group B) had such coloured pileus (contrary to the group with purple-brown pileus, where all fruitbodies had purple-brown or red-brown colour of pileus cuticle and 14 of 26 frutbodies had pileus cuticle darker on the margin than in the centre). Therefore, I consider it more likely that the fruitbodies with purple-brown or red-brown pileus cuticle (group A) growing especially in summer months in submontane to subalpine forests fit better into the original concept of *Russula xerampelina* (Schaeff.) Fr., than fruitbodies of group B. The different usage of the name *R. xerampelina* by the majority of present authors as well as the possible identity of this taxon with *R. graveolens* Romell or related taxa (see notes on Blum 1961 below) do not make it a commendable nomenclature; I accept this name in a new sense, and for that reason I'm applying for the group A the later published name *R. favrei* M. Moser (see notes on Moser 1979 below). In order to avoid disadvantageous changes in the nomenclature of well-known species, I will propose conservation of the name *R. xerampelina*, based on a neotype that allows continued usage of the name in its present sense. The name *R. xerampelina* then remains a synonym of *R. erythropoda*).

Schaeffer (1774) did not designate the type of the name *Agaricus xerampelinus* and his figures "Tab. CCXIV & CCXV" (Schaeffer 1771) would otherwise represent the only original material suitable for selection of a type.

Tab. 1. Original diagnoses and important descriptions of selected names of taxa closely related to *Russula xerampelina*

Agaricus xerampelinus Schaeff. (Schaeffer 1774):
Agaricus caulescens, solitarius, carnosus; pileo fusco - purpureo, punctato, primum globoso, dein convexo, planiusculo, centro depresso; lamellis crassis, flavis; petiolo tereti, brevi, crasso, pleno, cum purpura albido; velo et annulo destitutus.

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[1] The expression "fusco-purpureus" could be translated as "dark purple" or "brown-purple". The original Latin description is followed by two rows in German, where Schaeffer (1771) describes the colour of pileus cuticle as "purpurfarb und bräunlich".

Tab. 1 (continued)

Russula xerampelina **(Schaeff.) Fr. (Fries 1838):**
R. xerampelina, mitis, pileo carnoso compacto convexo-explanato depressoque sicco opaco laevi rimulosoque, margine recto laevi, carne compacta albolutescente, stipite valido firmo clavato laevi albo rubellove, demum spongiosomolli, lamellis adnexis subconfertis postice furcatis ex albo alutaceis. Schaeff. t. 214, 215. Krombh. t. 68. f. 13, 14 ex habitu iconis non fucatae. A. tinctorius. Secr. n. 487. var.! In pinetis campestr. passim, at raro. Ut prior ad R. emeticam haec ad R. integram accedit, differt substantia firma, pellicula pilei non distincta, quare pileus semper siccus, vulgo rimuloso-punctatus. Pileus roseo-purpureus, disco expallens, albo-lutescens. Sporidia sordide alutacea. Stipes udus magis rubet.

Russula erythropoda **Peltereau (1908):**
Stipe longtemps ferme, égal, entièrement d'un beau rose-rouge, plus rarement rosé seulement d'un seul côté; chapeau convexe, puis creusé, ferme, d'un beau rouge sombre (Sacc. chr., 12, 13), noirâtre au centre qui reste généralement plus foncé, même en vieillissant, à aspect mat, très peu decolorant et ne prenant jamais de teintes ocracées ou olive; chair douce, crême, mince au bord du chapeau qui est un peu strié dans la vieillesse; feuillets appointis près du stipe, arrondis extérieurement, blanchâtres, puis jaune de Naples (Ochroleucus Sacc., 28); spore ochracée, sphérique, grénelée, 10 µm.

Russula xerampelina **var.** ***amoenipes*** **Romagn. ex Bon (1987):**
A. typo differt pileo +/- purpureo-vinoso, discum versus interdum atropurpureo, stipite subvelutino persicino-roseo (Sicut in R. amoena). Sporibus 7-9 × 5-7 µm, spinis curtioribus 0.5 (0.8) µm, epicutis pilis +/- ampullaceis usque × 10-13 µm.

Russula favrei **Moser (1979):**
Pileo 3.5-11 cm lato, semiorbiculari vel irregulariter convexo, centro depresso, languido, incarnato-brunneo, rufo-brunneo, olivaceo-brunneo, interdum centro fere fuligineo, lamellis cremeis, pallide ochraceis, subconfertis, acie interdum brunneolo, stipite cylindraceo subclavatove, 3.5-9 cm/10-30-(45) mm, albido, dein ochrascente vel brunnescente, interdum basi roseolo tinctu, leviter ruguloso, carne alba, centro subbrunnescente, odore dulcidulo, fungoso, aetate interdum leviter piscino, sapore miti, carne $FeSO_4$ ope primo reactionen roseam, dein viridi-griseam praebente, sporis in cumulo ochraceis. Sporis (8) 9-10.5 (13)/(6) 7-8 (9) µm, ornamentatione verrucosa, 0.5-1 µm alta, cystidiis 60-80-110/12-17 µm, epicute e hyphis plus minusve subclavatis dermatopseudocystidiisque sulfovanillinae ope coerulescentibus formata.

Fries (1838) published the combination of *Agaricus xerampelinus* in the genus *Russula*, but his description of this species differs from the original diagnosis (see Tab. 1). He indicated the colour of the pileus as "pileus roseo-purpureus, disco expallens, albo-lutescens" (pileus rose-purple with yellowish-white discolouring centre), flesh as "ad R. integram accedit, differt substantia firma" (firmer than in *R. integra*) and habit as "in pinetis campestr." (in plain pine forests). The most likely application of the name *R. xerampelina* in sense of Schaeffer refers to a species that has a purple-brown pileus cuticle, of which observed specimens (see first part of this study, Adamčík & Marhold 2000) with such coloured pileus grew in submontane or montane forests especially under trees of *Picea*. Fries' description of *R. xerampelina* corresponds better to the present application of *R. xerampelina* and is possibly the same as the species also known as *R. erythropoda* Peltereau, although this species has a pileus cuticle in the centre dark purple black to black and discolouring only rarely on small spots and does not have firm flesh (the flesh has the same consistency as in *R. integra*).

Agaricus xerampelinus Schaeff. (Schaeffer 1774) was published before the starting point of the nomenclature of fungi according to pre-1983 editions of the International Code of Botanical Nomenclature (ICBN) and the valid publication place of this name was cited as *Russula xerampelina* "Schaeff. ex Fr." (Fries 1838). Probably that was

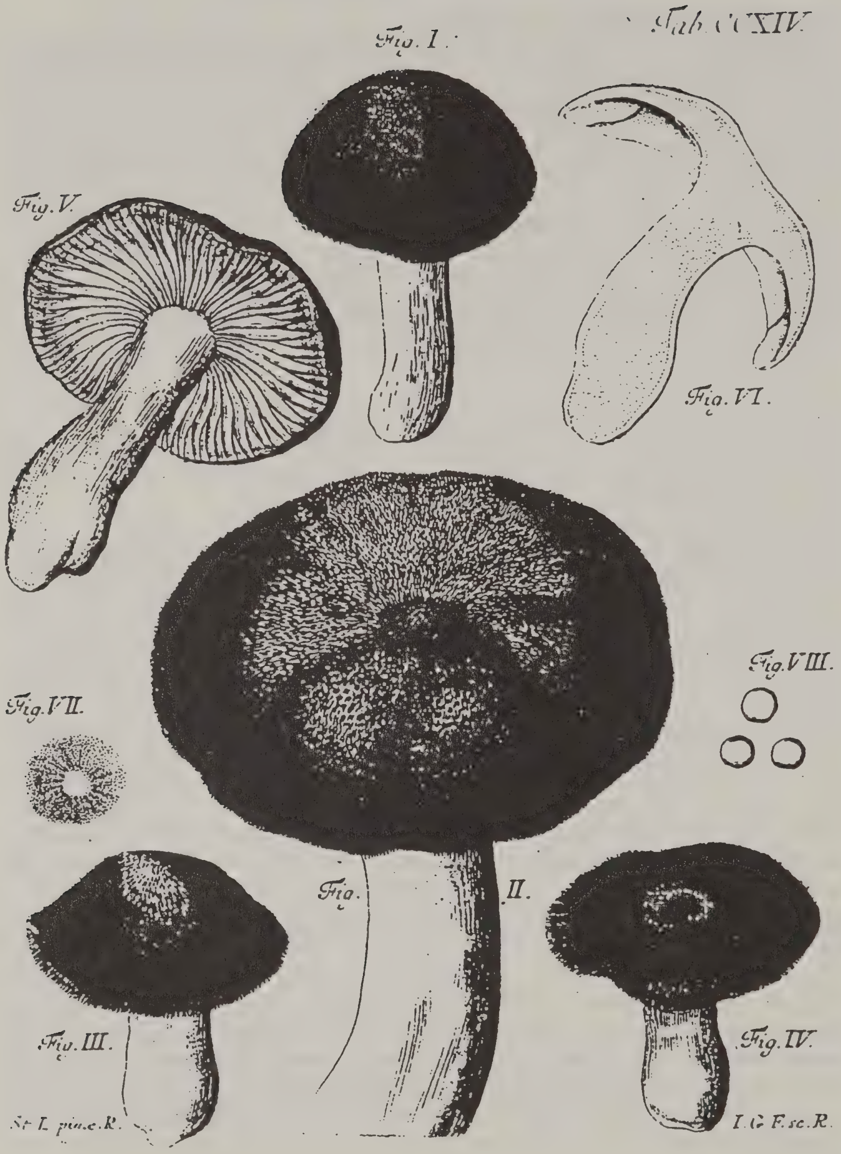
Tab. CCXIV.
Fig. I.
Fig. V.
Fig. VI.
Fig. VIII.
Fig. VII.
Fig. II.
Fig. III.
Fig. IV.
St L pin.c.R.
I.G F.sc.R.

Fig. 1. Lectotype of *Russula xerampelina* (Schaeffer 1771:Tab. CCXIV).

one of the reasons why mycologists generally preferred Fries' conception of *R. xerampelina* and synonymized this name with *R. erythropoda*, such as ROMAGNESI (1967), MOSER (1983), EINHELLINGER (1987), BON (1988), KNUDSEN & STORDAL (1992), REUMAUX & AL. (1996), GALLI (1996).

FRIES (1838) described also new species *R. linnaei* based on LINNAEUS's (1753) unnamed variety *Agaricus integer* "β". RICKEN (1911) and VELENOVSKÝ (1920) considered *R. linnaei* as a species related to *R. xerampelina*. MELZER & ZVÁRA (1927a) transferred *R. linnaei* on the level of variety to *R. xerampelina*. However, *R. linnaei* in its original sense is not a species from section *Xerampelinae*, because Fries' descriptions of *R. xerampelina* and *R. linnaei* differ in characters usually used for delimitation of this section. FRIES (1838) described the flesh of fruitbodies as "carne spongioso-compacta alba" (white flesh) in *R. linnaei* and "carne compacta albolutescente" (flesh turning yellowish-white) in *R. xerampelina*. These two species are different according to Fries also in colour of spore print: white in *R. linnaei* and ochraceous in *R. xerampelina*.

MASSEE (1893) followed Schaeffer's description of *R. xerampelina* (pileus cuticle being purple-brown), but in his sense this species does not belong to the section *Xerampelinae*. The flesh of fruitbodies of *R. xerampelina* is according to Massee yellowish. He also did not mention its remarkable smell. On the contrary, all taxa of section *Xerampelinae* he classified into one species - *R. vesca*: they have flesh turning rusty-colour and on age having a crab-like smell.

PELTEREAU (1908), who commented on the taxa related to *R. alutacea*, accepted the name *R. erythropoda* for a related taxon with dark red and not discolouring pileus associated with coniferous trees. According to him FRIES (1874) was the author of this epithet describing the "forma speciosa *erythropoda*" of *R. alutacea*. To my understanding of the Code FRIES (1838, p. 362) mentioned, while describing *R. alutacea,* only a beautiful form, for which the epithet *erythropoda* could be used. There is no reason to consider the name *R. alutacea* f. *erythropoda* having been validly published[2]. The epithet "*erythropode*" is not in accordance with Art. 24.1 of the Code (GREUTER & AL. 2000), because it is not definitely (but only indirectly) connected with a term denoting its rank and this epithet is separated from the category "forma" by the word "speciosa" and a colon. It is also in conflict with Art. 24.2 of the Code because the name does not agree grammatically with the generic name. Later FRIES (1874, p. 453) reported the same form with red stipe as "sed in forma speciosa erythropode" (without colon). But also here "erythropode" was not directly connected with the category "forma" and it was not grammatically identical with the generic name. That's why I accept PELTEREAU (1908) as the author of the name "erythropoda".

I have discussed the question of a valid publication of the name *R. alutacea* f. *erythropoda* 'Fr.' with T. Kuyper and Z. Pouzar who agree that the name was not validly published by Fries. J. Melot, in accordance with my interpretation, also agrees that FRIES (1838, 1874) has not published a new infraspecific taxon of *R. alutacea*.

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[2] The word "speciosa" FRIES (1838, 1874) was not written in italics, but in some cases he did not use italics also for some species names (such as "R. alutacea" in FRIES 1874, the last line of the page 453). On the opposite, the word "*erythropode*" is in italics, but FRIES (1838, 1874) used italics for indicating important characters in the description. However, speciosa is still in the ablatives and does not grammatically agree with the species and generic name (Art. 24.2).

Peltereau's description (PELTEREAU 1908) of *R. erythropoda* lacks characters typical for the section *Russula* sect. *Xerampelinae* (such as flesh turning yellowish or brownish and crab-like odour of older fruitbodies) and his treatment of this taxon in section *Xerampelinae* may be questionable (for the original diagnosis see Tab. 1). He believed that *R. erythropoda* is related to *R. alutacea* which is not a member of the section *Xerampelinae*. BARBIER (1908) treated *R. erythropoda* as a form of *R. alutacea*.

Characters presented in the description of *R. erythropoda* (PELTEREAU 1908), such as association with coniferous trees, dark red colour of pileus cuticle on the margin and almost black in the centre, pileus cuticle without ochraceous or olive spots, stipe almost entirely pinkish-red, spore print ochraceous, taste mild, correspond with ROMAGNESI'S (1967) concept of *R. erythropoda*. Although I can not definitely disprove Barbier's concept (that *R. erythropoda* could be related to *R. alutacea*), I'm following Romagnesi and the majority of present-day mycologists who classify *R. erythropoda* as a member of sect. *Xerampelinae*. I consider two groups with purple pileus cuticle (marked as group „B“ in the numerical analyses, ADAMČÍK & MARHOLD 2000) as conspecific with *R. erythropoda*. For reasons of nomenclatural stability, however, I will continue to use the name *R. xerampelina* for the taxon. PELTEREAU (1908) did not designate a type for *R. erythropoda* and only cited 5 illustrations by various authors who described, according to him, "perfectly the aspect of coloration" of *R. erythropoda* but some of them evidently represent different taxa.

MAIRE (1910) applied a wide concept of *R. xerampelina*. His concept of this species includes all taxa of the present section *Xerampelinae*. This conception was followed by SINGER (1926, 1932), MELZER & ZVÁRA (1927a, 1927b), MELZER (1945), SCHAEFFER (1933) KÜHNER & ROMAGNESI (1953) and BLUM (1961, 1962). KONRAD & FAVRE (1933) reduced *R. erythropoda to* varietal status under *R. xerampelina* (sensu Maire), which was followed by other authors (such as BLUM, 1961). According to the description of the colour of the pileus cuticle and habitat, SINGER (1926) and SCHAEFFER (1933) applied the name *R. erythropoda* to *R. xerampelina* var. *rubra* (Britzelm.) Singer, KÜHNER (1953) applied the name *R. favrei* to *R. xerampelina* var. *fusca* (Quél.) Melzer & Zvára and MELZER & ZVÁRA (1927a, 1927b) misapplied the name *R. erythropoda* to *R. xerampelina* var. *linnaei* and *R. favrei* probably to *R. xerampelina* var. *fusca*. MELZER (1945) created a new name - *R. xerampelina* var. *putorina* nom. inval. *R. xerampelina* var. *putorina* is associated with coniferous trees and has a mainly brown coloured cuticle of pileus with violet and olive-colour tints. I consider it highly likely that this taxon is synonymous with *R. favrei*.

VELENOVSKÝ (1920) distinguished several taxa related to *R. xerampelina: R. atrosanguinea* (described by VELENOVSKÝ, 1920 as sp. nova), *R. xerampelina*, "*R. erythropus*" and *R. linnaei*. No herbarium material of these species was preserved by Velenovský, and the descriptions of these species are very brief, but my interpretation of these short diagnoses suggests that all these species described by Velenovský are probably conspecific with *R. erythropoda*, because they have a purple pileus cuticle and grow in coniferous forests.

Problematic is also the application of the name *R. fuscoochracea* R. Schulz (MICHAEL & SCHULZ, 1926), for the same reasons as in Velenovský's species. *R. fuscoochracea* R. Schulz was said to have a mainly brown coloured pileus cuticle (also with purple and olivaceous tints) and to grow in montane coniferous forests. Hence, *R. fuscoochracea* R. Schulz is probably conspecific with *R. favrei* or *R. clavipes* Velen. (another taxon of section *Xerampelinae* with a mainly olive-coloured pileus cuticle). *R. fuscoochracea* R. Schulz is later homonym of *R. fuscoochracea* VELENOVSKÝ (1920), a species not from section *Xerampelinae*.

LANGE (1926) described a member of sect. *Xerampelinae* under the name *R. purpurea* Gillet. Subsequently, Lange (1940) reintroduced the name *R. xerampelina* for that taxon, while simultaneously expressing that that name is liable to confusion as it had been used in a restricted sense (for the species under pines with deep blood-red pileus with darker centre) and in a wide sense for all members of sect. *Xerampelinae*, which Lange thought are better kept apart.

CRAWSHAY (1933) presented a wide concept of *R. xerampelina*, much wider than SCHAEFFER (1774). *R. xerampelina* was in his sense the species associated with coniferous and deciduous trees with purple, ochraceous and brown coloured cuticle of pileus.

BLUM (1961) too had a wide conception of *R. xerampelina* including all taxa of section *Xerampelinae*, and he supposed that type variety of *R. xerampelina* is identical with *R. xerampelina* var. *quercetorum* Singer, which is a taxon from deciduous forests related to *R. graveolens* Romell. It is true that SCHAEFFER (1774) did not mention anything about the ecology of *R. xerampelina*, and it is also true that *R. graveolens* can have a similar colour of the pileus cuticle as *R. xerampelina*. According to my observations of material of section *Xerampelinae* from deciduous forests, there are only few fruitbodies with a combination of purple and brown colour of the pileus cuticle, and these colours are mainly combined with olivaceous or flesh-red colours. If the fruitbodies from deciduous forests have a darker colour of the pileus cuticle on the margin, then they are discolouring more to olivaceous colour. Accordingly, no taxon of section *Xerampelinae* described or indicated from deciduous forests has the combination of these two colours as described in the original description of *A. xerampelinus* (see Tab. 2).

BLUM (1962) classified *R. graveolens* var. *subrubens* J. E. Lange as a form of *R. xerampelina* var. *erythropoda* (a taxonomic synonym of *R. erythropoda*). However, *R. subrubens* (J. E. Lange) is a separate species associated with *Alnus* and *Salix* in floodplain forests (BON 1972).

ROMAGNESI (1967) considered *R. erythropoda* as a synonym of *R. xerampelina*. He designated the types, by which he most likely meant characteristic or typical collections, for almost all species accepted in his monograph (also for the species, which already have nomenclatural types) from specimens collected by him, but for *R. xerampelina* he choose as type only spore print: "Type: sporeée no 7-IX-63". He indicated the colour of the spore print as IIIc according to his scale, which corresponds to fruitbodies of the taxon with purple pileus cuticle (*R. xerampelina* or *R. erythropoda*) observed in this study. Romagnesi's designation of a neotype of *R. xerampelina* is not valid, because other original material (lectotype material) is available: pl. 214 and 215 of Schaeffer (1774), according to Art. 9.6 of the Code. As a candidate neotype, intended to fix the application of the name *R. xerampleina* in its present sense, it is also not suitable, as a spore print only does not provide sufficient details to fix the name.

Romagnesi (1967) distinguished another taxon with a similar colour of the pileus cuticle from coniferous forests apart from *R. xerampelina*: *R. amoenipes* Romagnesi nom. inval. This name was later accepted at the level of variety of *R. xerampelina* and validly published by Bon (1987, for the original diagnosis see Tab. 1). According to my study of the type material, I found many differences in microscopic structures with the taxon here called *R. xerampelina* (= *R. erythropoda)* and also from other material of section *Xerampelinae*. I therefore regard this taxon as a separate species *R. amoenipes* (Romagnesi ex Bon) Bidaud, Moënne-Loccoz & Reumaux (combination on the level of species by Reumaux & al. 1996). Specific characters observed on the type specimen of *R. amoenipes* are size of terminal cells of pileocystidia, which are very wide and short, very small and narrow spores with spines densely connected with line connections and different shape of terminal cells of generative hyphae[3] on the margin (subulate) and in the centre (mainly inflate) of pileus epicutis. Romagnesi described this taxon only "ad inter.", because he found only one fruitbody. The question remains if this fruitbody could not be determined as belonging to some of the numerous taxa from deciduous trees (Romagnesi found it in planted forest of *Pinus sylvestris*). I compared microscopic characters of the type specimen of *R. amoenipes* with specimens or descriptions of all taxa accepted and collected by Romagnesi (including invalid taxa described "ad inter.") and with all my material of section *Xerampelinae*, but no observed fruitbodies have a similar combination of characters. The most similar taxon is *R. clavipes*, which also has small and narrow spores and similar generative hyphae in the pileus epicutis, but the spines are only scarcely connected with lines, the pileocystidia do not exceed 8 µm and the colour of pileus cuticle is mainly olive.

Tab. 2. Colour of pileus cuticle of taxa of *Russula* sect. *Xerampelinae* with validly published names described or indicated from deciduous forests according to original description with authors and dates of their publication.

Author and date of publication	name of taxon	description of colour of pileus cuticle
Phillips in Cooke 1883	R. duportii	the centre rufous, or flesh red, margin bluish
Britzelmayr 1891	R. graveolens	purpurroth, weinfarben
Britzelmayr 1891	R. graveolens f. rubra	rot
Velenovský 1920	R. quercetorum	sytě až temně nachový s tonem lilákovým [deeply to dark purple with lilac tint]
Velenovský 1920	R. pruinosa	šedave lilákový [greyish lilac]
Lange 1940	R. graveolens var. subrubens	cupreo-rubro
Romagnesi 1962	R. faginea	sordide rubido, e roseo brunneo, cacaino, medie saepe citrino vel e viridi flavo tincto
Romagnesi 1967	R. amoenoides	lepide purpureo, ad instar R. amoena

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[3] We used the term „undifferentiated hyphae“ in the first part of this study (Adamčík & Marhold 2000). However, B. Buyck suggested to replace this term with „generative hyphae“. I regard this suggested term more accurate, and I make the replacement in this paper.

Tab. 2 (continued)

Author and date of publication	name of taxon	description of colour of pileus cuticle
BON 1987	R. brevis	± rubris vel brunneo-roseis (R. velenovskyi vel vescae instar), margine saepe ± vinoso vel discum versus ochracei vel subolivaceis
BON 1987	R. cicatricata	cupreis vel aerino-olivacei, rarius brunneo purpureis, praecipue marginem versus, sed disco cito ± ochraceo-sepiaceo
BON 1987	R. gilvescens	coloribus variabilibus, roseis, vinosis cum disco ± cupreo-olivaceo, sed cito decolorantibus, postremo sordide ochraceo brunneis, ac margine diu roseo
BON 1987	R. graveolens var. megacantha	[not different from type]
BON 1988	R. graveolens var. pseudomelliolens	cupreo-roseis (R. melliolentis instar)
KÄRCHER 1996	R. schaefferi	uniformiter olivaceo, griseo-olivaceo centro plus minusve cito melleo-olivaceo, interdum virido-pallescente, sed etiam olivaceo-brunneo; ad marginem interdum paulo brunneo-roseo (Russula vescam in mentem revocante)
Reumaux in REUMAUX & AL. 1996	R. amoenoides var. gracilipes	purpureo-violaceum centro purpureo-violeceum centro purpureo-nigro, aliquotiens cum nonnullis ochraceo-flavis maculis
Reumaux in REUMAUX & AL. 1996	R. duportii f. spinulosospora	[not different from type]
Reumaux in REUMAUX & AL. 1996	R. pseudomelliolens	cupreo-rubellum R. melliolentis instar, saepe in medio fuscum cum magis rosaceis ad marginem coloribus
Reumaux in REUMAUX & AL. 1996	R. purpurea var. subamoenipes	[not different from type]
Reumaux in REUMAUX & AL. 1996	R. purpurissata	saturate violaceo-purpureum centro nigello
Reumaux in REUMAUX & AL. 1996	R. rubida	purpureo-rubrum unicolor vel centro purpureo-nigro

MOSER (1979) published a new species called *R. favrei* (for the original diagnosis see Tab. 1), because he considered *R. xerampelina* and *R. erythropoda* as synonyms and he noted the differences between fruitbodies from subalpine zone and other taxa from the *R. xerampelina* group. He specified for *R. favrei* the following discriminant characters: dominant colour of pileus cuticle is brown; stipe is white, then turning more or less brownish; the smell of flesh is in fresh condition null, then can be only slightly crab-like or can be entirely missing; reaction of flesh to $FeSO_4$ is initially pink, soon turning grey-green to green; habitat under *Picea* and *Pinus cembra* in subalpine forest. I have observed that discoloration of flesh, reaction of flesh to $FeSO_4$ and smell of flesh are characters depending on the age of fruitbodies, and I regard these characters as unsuitable for identification. Some fruitbodies of the group of fruitbodies with purple-brown or red-brown pileus cuticle resulting from the multivariate analyses (ADAMČÍK & MARHOLD 2000, the group was labelled as "A") have clearly white stipe and two collections came from altitudes over 1000 m under *Picea* (in Nízke Tatry mountains and in Západné Tatry mountains). The results of my study on type specimen of *R. favrei* are different from Moser's description of the

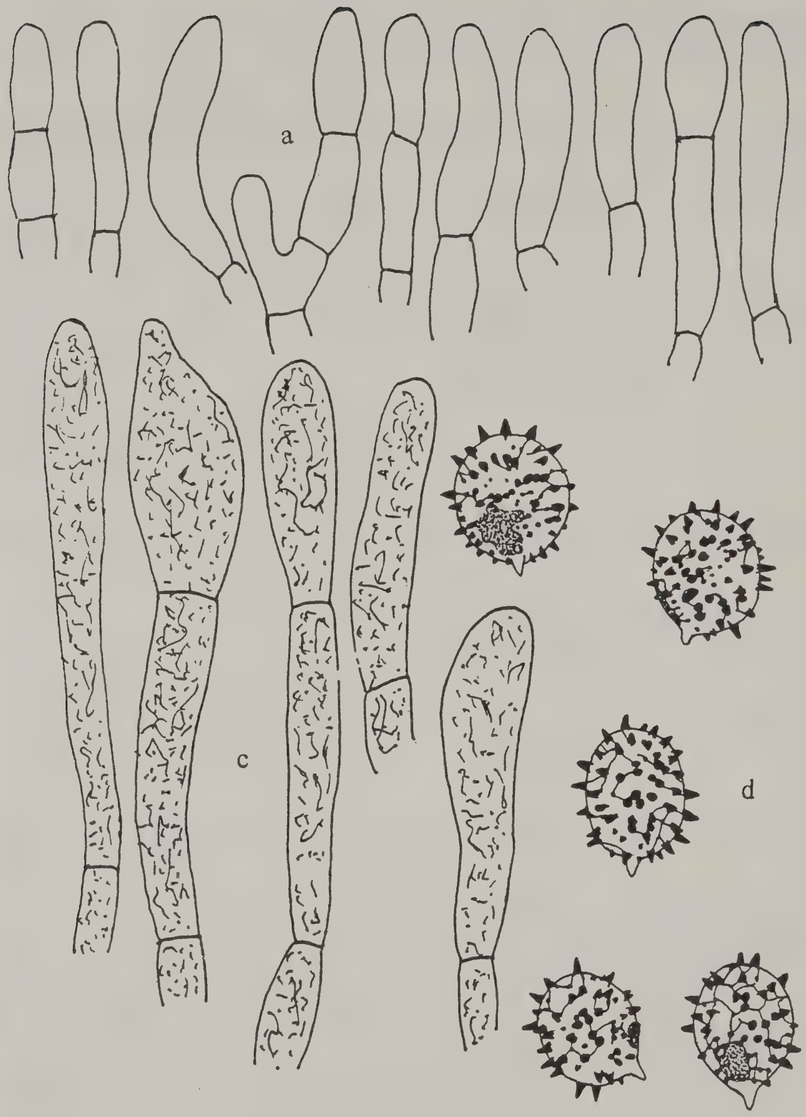

Fig. 2. Microscopic structure of holotype of the name *Russula favrei* (Moser, IB 75/95), which I consider to be a synonym of *R. xerampelina*. a. – generative hyphae on the margin of pileus epicutis (1000 ×), c. – pileocystidia (1000 ×), d. – spores (1600 ×).

micromorphological characters, but similar to those observed in fruitbodies of the group A. I have found spores with size 8.7-10.3 × 6.9-8.7 µm and with spines length 0.8-1.2 µm, but Moser indicate height of spore ornamentation only 0.3-1 µm. This difference could be caused by heterogeneity of the type collection, which includes a spore print with mature spores and a fruitbody with immature spores (and not well developed ornamentation). Prof. Moser acknowledged me in a letter, that the spore print is from the same collection as the fruitbody. Moser's description and accessory figure of the structure of the pileus epicutis of *R. favrei* is also different from my observation on the type material. The "type" fruitbody was poorly conserved and on the surface of the pileus epicutis are hyphae of a parasitic fungus. It was problematic to find well-preserved hyphae in the pileus epicutis. There were observed a few not deformed hyphae (Fig. 2.) which are similar to those of group A. Accordingly, I treat *R. favrei* as the correct name for fruitbodies of the group A. *Russula favrei* is distinguished from *R. xerampelina* (= *R. erythropoda*) also by BON (1988) and KNUDSEN & STORDAL (1992).

AICHER (1996) noted a difference in coloration of pileus cuticle between the original description of *R. xerampelina* and the concept of the majority of present authors. She claimed that, on the basis of pl. 214 and 215 (Schaefer 1774), it is not possible to synonymize *R. erythropoda* with *R. xerampelina*, because the illustrations do not present dark purple-black colours in the centre of pileus cuticle (as occurs in *R. erythropoda*). She regarded *R. xerampelina* and *R. amoenipes* to be conspecific.

REUMAUX & AL. (1996) accepted other taxa with purple or similar coloured pileus cuticle associated with coniferous trees and related these to *R. xerampelina*: *R. atrosanguinea*, *R. abietum* and *R. favrei*. They described new species from this range (although three of them under invalid names): *R. rivulosa* Reumaux nom. inval., *R. brevissima* Moënne-Loccoz, *R. suberythropus* Moënne-Loccoz nom. inval. and *R. subpurpurea* Reumaux nom. inval. They made also new combination: *R. amoenipes* (Romagnesi ex Bon) Bidaud, Moënne-Loccoz & Reumaux. I have not studied the material collected by Reumaux & al. and labelled with these species names and can only suppose their relation with taxa accepted in our study. Whereas the classification of species by these authors is based mainly on colour of pileus and habitat, several names are probably synonyms of *R. favrei* and *R. xerampelina* (= *R. erythropoda*), but in order to arrive at a final clarification further study are needed.

R. abietum differs from *R. favrei*, according to REUMAUX & AL. (1996) by presence of "multiseptate hyphae", large spores with subreticulate ornamentation and light yellow spore print. With exception of colour of spore print, these characters fall under the natural variability of *R. favrei*. The figures of *R. abietum* and *R. favrei* also represent distinctly clavate terminal cells of hyphae in pileus epicutis similar to my observations on *R. favrei*. Hence, for the time being and pending a study of the holotype, I regard *R. abietum* and *R. favrei* in a sense of these authors as conspecific. *R. abietum* was described by BLUM (1953) as *R. xerampelina* var. *abietum* and BON (1983) made the combination on the level of species. According to Blum the colour of pileus cuticle is not purple-brown, but vinaceous, rosy or rosy-brown. I have not studied any specimens of *R. abietum* identified by Blum, but I have studied material collected by Bon. The terminal cells in the centre of pileus epicutis are inflated as in *R. faginea*, accordingly I expect that *R. abietum* is not related to *R. favrei* or *R. xerampelina*. *R.*

fuscoochracea Schulz. in the sense of Reumaux & al. is related to *R. clavipes* (dominant colour of pileus cuticle is green or olive-colour).

R. rivulosa, *R. brevissima*, *R. atrosanguinea*, *R. subpurpurea*, *R. suberythropus*, *R. marthae* and *R. amoenipes* in the sense of REUMAUX & AL. (1996) resemble in colour of pileus cuticle *R. xerampelina* (= *R. erythropoda*). The figures of microscopic structures of this species show that all taxa with the exception of *R. rivulosa*, have attenuated or constricted terminal cells of generative hyphae of the pileus epicutis (this is an important differential character between *R. xerampelina* and *R. favrei*). However, *R. rivulosa* has very narrow terminal cells of generative hyphae and according to descriptions of the authors it can not be synonymized with any species accepted in our study. Some characters similar to those of *R. amoenipes* measured on type specimen (see above) occur according to Reumaux & al. in *R. amoenipes* and *R. subpurpurea*. *R. amoenipes* in sense of these authors has small spores (7-8.5 × 5.5-7 µm) and *R. subpurpurea* has wide dermatocystidia (8-12 µm). The authors did not mention the width of pileocystidia of *R. amoenipes* and they indicated 5-8-13 µm wide generative hyphae in the pileus epicutis. In the type specimen these hyphae were so wide only on the centre of the pileus epicutis, but their shape was different from that presented in the figure. On the contrary, more similar to the type specimen of *R. amoenipes* is the description of generative hyphae of *R. subpurpurea*, which are said to be 3-5 µm wide, but on the figure spores are presented without line connections. Possibly, *R. subpurpurea* and *R. amoenipes* sensu Reumaux & al. are synonyms of *R. amoenipes*, but I have not found enough characters necessary for this conclusion in the descriptions of these authors. Further studies are needed to clarify the identity of these taxa. I accept only three species with purple pileus cuticle from coniferous forests, and I therefore suppose that further species names (namely *R. rivulosa*, *R. brevissima*, *R. atrosanguinea*, *R. suberythropus* and *R. marthae*) refer to the species *R. xerampelina* (= *R. erythropoda*).

Key to the European taxa of section *Xerampelinae* with purple, purple-brown to red-brown pileus cuticle associated with coniferous trees.

1A. In the centre of pileus epicutis terminal cells of generative hyphae wider than 7 µm present. Pileocystidia very wide, 26.5-62 × 8-13.5 µm. Spores small, (7.3-)8.1-8.7 × 6.1-6.7 µm. Surface of pileus cuticle velvety-granulose. Growing in coniferous forests in the planar zone.
Russula amoenipes

1B. Terminal cells of generative hyphae in the centre of pileus epicutis thinner than 7 µm. Width of pileocystidia only rarely exceeding 10 µm. Spores mostly longer than 9 µm. Surface of pileus cuticle not velvety-granulose 2

2A. Pileus cuticle purple-brown, red-brown to purple-black. Spore print ochraceous, IIIb according to ROMAGNESI's (1967) scale. Spores large, (8.6-)9.2-11.3(-12.3) × (6.7-)7.3-8.6(-9.2) µm. Pleurocystidia without appendage or with a short one (shorter than 3 µm). Terminal cells of generative hyphae on the margin of pileus epicutis mainly clavate or cylindric and in the terminal part not narrower than 3 µm. Growing in submontane to subalpine coniferous forest from June to August
Russula favrei

2B. Colour of pileus cuticle purple to purple-black in the centre. Spore print pale yellow, IIIc-IVa according to ROMAGNESI's (1967) scale. Spores smaller, very rarely exceeding 10 µm length. Pleurocystidia with mostly long (longer than 3 µm) appendage. Terminal cells of generative hyphae on the margin of pileus epicutis mainly subulate or attenuate, in the terminal part narrower than 3 µm. Growing in planar to submontane coniferous forests from September to November 3

3A. Pileus (4.8-)5.7-7.3(-8.2) cm wide, pileus margin striated to 3-12 mm. Stipe 1.3-1.9(-2.3) cm thick, cortex of stipe (1-)1.5-2 mm thick, flesh in the half of pileus radius 2-3.5 mm thick. Hymenium with (79-)99-162 lamellae
Russula xerampelina **var.** ***tenuicarnosa***

3B. Pileus (3.7-)5.3-9.5(-10.7) cm wide, pileus margin striated to 0-9 mm. Stipe (1.2-)1.5-3 cm thick, cortex of stipe 1.5-3.5(-4) mm thick, flesh in the half of pileus radius (2.5-)3.5-6.5 mm thick. Hymenium with more dense lamellae, (138-)141-202(-234)
Russula xerampelina **var.** ***xerampelina***

Taxonomic account of the taxa of the *Russula xerampelina* group in Europe

Russula amoenipes **(Romagnesi ex Bon) Bidaud, Moënne-Loccoz et Reumaux** in Reumaux, Bidaud et Moënne-Loccoz, Russules rares ou méconnues: 281, 1996 (Fig. 3.)

≡ *Russula xerampelina* var. *amoenipes* Romagnesi ex Bon, Doc. Mycol. 18 (69): 36, 1987.

Holotypus: [France] "Dans une plantation de *Pinus silvestris*, sur sol siliceux, Thiers (Oise)" (PC, coll. Romagnesi 58180).

[*Russula amoenipes* Romagnesi, Les Russules d'Europe et d'Afrique du Nord: 687-688, 1967; nom. inval., Art. 36.1]

Description of macromorphological characters according to ROMAGNESI (1967):

Pileus 6.8 cm diam., fleshy, plane, slightly depressed in the centre, margin very shortly and indistinctly striated, cuticle separable to half of pileus radius, surface of the cuticle densely velvety-granulose under magnifying glass, rather shining. Colour of pileus cuticle distinctly different from *R. xerampelina*: rusty-vinaceous coloured on the margin, brownish-red towards the centre and purple-black in the centre.

Stipe 5 cm long, 1.5 cm thick, upwards thickened, downwards slightly attenuate, lightly soft and spongy-stuffed, bright rose-carmine (resembling *R. amoena*), turning to brownish-honey colour, very fine and regularly striated on the surface.

Lamellae not very dense, rigid, with some long lamelullae, rarely furcate, free, ventricose, rounded towards the margin of pileus, 7 mm wide, pale cream-ochraceous, than pale ochraceous, with concolours edge, rather distinctly intervenose.

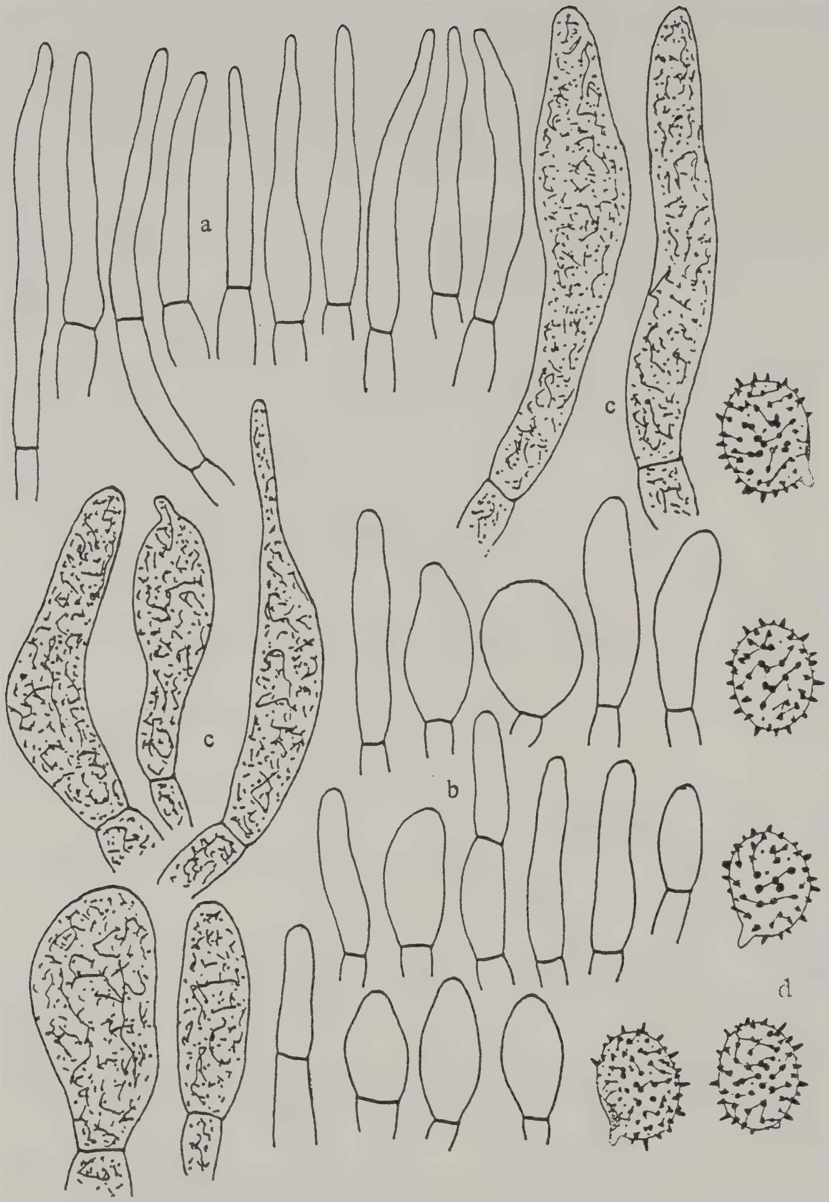

Fig. 3. Microscopic structure of holotype of the name *Russula amoenipes* (PC, coll. Romagnesi 58180). a. – generative hyphae on the margin of pileus epicutis (1000 ×), b. – generative hyphae on the centre of pileus epicutis (1000 ×), c. – pileocystidia (1000 x), d. – spores (1600 ×).

Flesh thick, compact but not firm, white above lamellae, turning yellow minutely in cortex of stipe and turning more yellow in clots of medulla of stipe. Smell and chemical reactions as in *R. xerampelina*.

Spore print ochraceous (IIIb according to ROMAGNESI, 1967).

Description of micromorphological characters according to observation on the type specimen:

Basidia 32-39 × 9-11 (-12) µm, short and narrow.

Pleurocystidia 63.5-72.5 × 10-11.5 µm, appendiculate (appendage 5-11 µm long), often constricted and mostly rounded in the terminal part.

Spores (7.3-)8.1-8.7 × 6.1-6.7 µm, narrow, Q = 1.25-1.37, spines 0.7-1 µm long and middle distant - 5-9 in the circle of diameter of 3 µm, amyloid punctations numerous - 0-5 in the circle, line connections frequent - 1.5-5 in the circle, contact connections also frequent - 0.5-5.5 in the circle, isolated spines rare.

Terminal cells of **generative hyphae** on the pileus epicutis on the margin 29-40.5 (-52) × 3-5 µm, narrow and long, subulate to attenuate, in the terminal part narrower than 3 µm. The terminal cells on the centre of pileus epicutis 14-29.5 × 4-13 µm, shorter and more inflated than on the margin (often wider than 7 µm), cylindrical or ellipsoid, rounded.

Terminal cells of **pileocystidia** 26.5-62 × 8-13.5 µm, very variable in shape: fusoid, cylindrical or also clavate, always distinctly inflated, in the terminal part rounded or acute, sometimes with appendage.

Habitat - known only from one locality in France, where grew in planted forest of *Pinus sylvestris* on the sandy silicate soil.

Specimens examined - **[France]** Thiers (Oise), dans une plantation de *Pinus sylvestris*, sur sol siliceux, 23.VIII.1958, Romagnesi (PC, coll. Romagnesi 58-180).

***Russula favrei* M. Moser**, Sydowia 31: 98, 1979
(Fig. 4., 5a.)

Holotypus: [Austria] "Ochsenkopf bei Obergurgl, Ötztal, Tirol, Nadelwald (*Pinus cembra* und *Larix*) an grasiger Stelle (Silikatboden), 25.08.1975, Moser" (IB, 75/95).

= *Russula fuscoochracea* R. Schulz in Michael et R. Schulz, Führer für Pilzkunde, Vol. 2: N° 241, 1926 [nom. ileg. – Art. 53.1], non Velen., 1920. Ind. loc.: [Germany] "Ziemlich selten in Gebirgswäldern. Er wurde bisher von Michael im Dogtlande, von Berfasser im Riesengebirge beobachtet." [Typus ignotus., ex descr. et icon.]

[*Russula xerampelina* var. *putorina* Melzer, Atlas holubinek: 155, 1945 ; nom. inval., Art. 36.1]

Misidentifications:

Russula elephantina auct. non (Bolton) Fr.: Kühner et Romagnesi, Flore analytique des champignons supérieurs: 449, 1953.

Russula abietum auct. nom (J. Blum) Bon: Reumaux, Bidaud et Moënne-Loccoz, Russules rares ou méconnues: 172-173, 1996.

Russula xerampelina var. *olivascens* auct. non Pers.: Galli, Le Russule: 374, 1996.

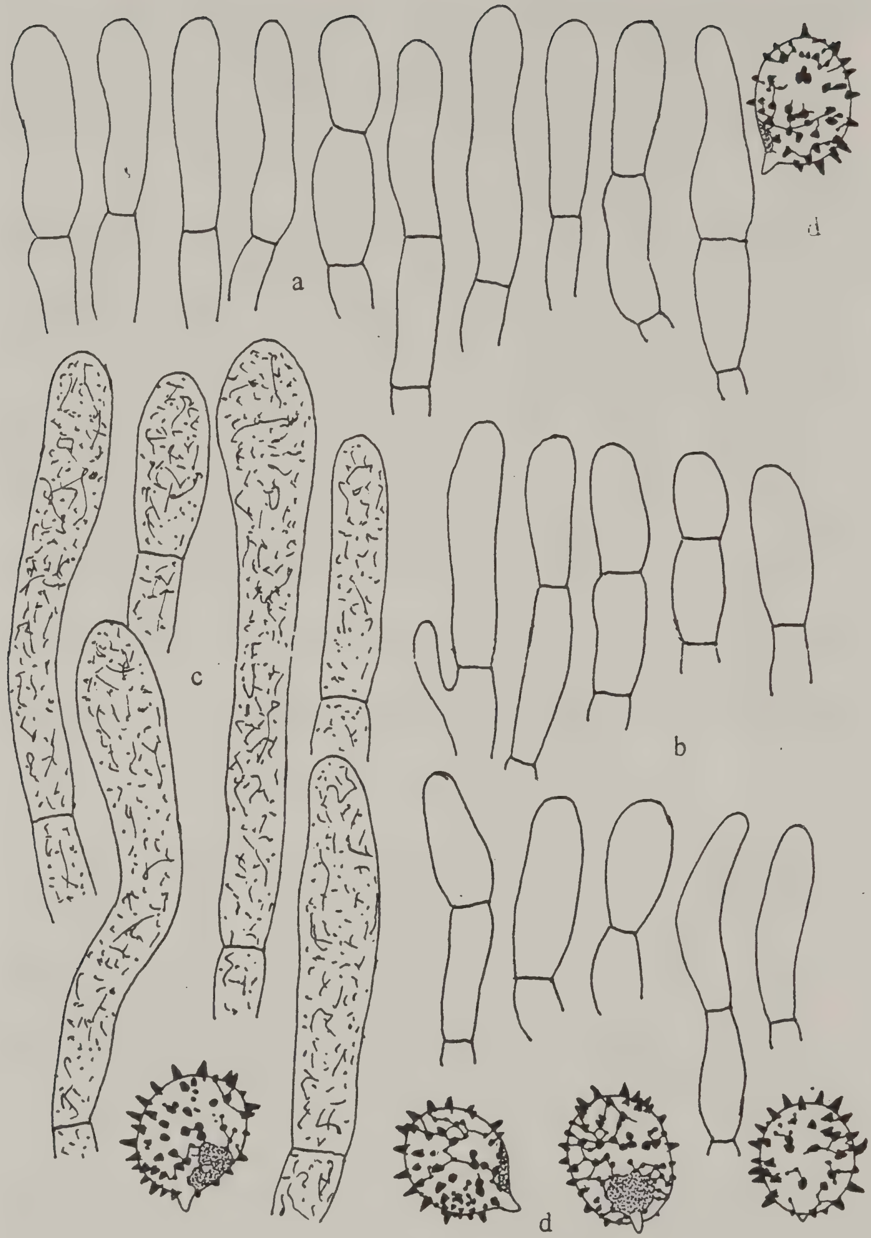

Fig. 4. Microscopic structure of epitype of the name *Russula xerampelina* (Adamčík, SAV). a. – generetive hyphae on the margin of pileus epicutis (1000 ×), b. – generative hyphae on the centre of pileus epicutis (1000 ×), c. – pileocystidia (1000 ×), d. – spores (1600 ×).

Pileus (2.4-)2.6-8(-9.2) cm diam., subglobose to convex when young, then expanded plane and slightly depressed at the centre to entirely applanate, frequently irregularly lobate, margin subobtuse to obtuse, striate to 0-12 mm from the margin to the centre, cuticle separable to 7-32 mm from margin. Cuticle of pileus on the margin purple-brown, chestnut-coloured to black-brown with purple tint, often discoloured on tobacco-brown to olive-brown, sometimes with thin bright purple zone on the margin, on the centre dark purple-brown, black-brown to entirely black, often discoloured on olive-brown, rusty-brown, tobacco-brown or cacao-brown, often on the centre discoloured and therefore on the margin darker. Surface of pileus cuticle in the middle zone rough and wrinkled, on the centre often scrobiculated, almost all mat or in the centre slightly shining. The pigment trace on the wet filter paper after chaffing on pileus cuticle is rose-brown to brown.

Stipe 2.3-6.5(-7) long, 0.9-2.3 cm thick, often excentric, cylindrical or clavate, the surface is mostly strongly striated, white and rose-tinged on one side, rarely completely white or more than on half of surface rose coloured, then slightly ochraceous, after bruising turning rusty-colour to brown, cortex 1-4 mm thick.

Hymenium with (90-)106-231(-251) lamellae, 0-8(-9) lamellulae and (0-)1-15(-34) furked lamellae (furkations mainly near the stipe). Lamellae 3.5-12(-18) mm wide, cream-coloured, also with yellow tint in frontal view, adnexed.

Flesh compact but not firm, white, in the cortex of stipe almost not changing colour, in the medulla of stipe turning brown, in the half of pileus radius 2-4.5 mm thick. Smell almost none in fresh condition, crab-like when drying or damping off. Reaction to $FeSO_4$ grey-green to blue-green when young, then less intensive and more with ochraceous tint.

Colour of **spore print** ochraceous (IIIb according to ROMAGNESI, 1967).

Basidia (30.5-)37-60.5(-66) × (9-)10.5-16(-19) µm, in some fruitbodies often very long and wide.

Pleurocystidia (61-)66.5-103.5(-114) × (10-)11-15.5(-18) µm, in majority of observed fruitbodies without appendage, only rarely constricted and mostly rounded in terminal part. If appendage present, than 1-3(-8) µm long.

Spores (8.6-)9.2-11.3(-12.3) × (6.7-)7.3-8.6(-9.2) µm, Q = 1.2-1.32, spines (0.6-)0.8-1.1 µm long and middle distant - (2.5-)4-7.5(-10) in the circle of diameter of 3 µm, amyloid punctations numerous - (0-)2-5.5(-8) in the circle, line connections frequent - 0-2.5(-4) in the circle, contact connections also frequent (0-)1.5-5.5(-8) in the circle. In spite of numerous line and contact connections of the spines and amyloid punctations some isolated spines present.

Terminal cells of **generative hyphae** on the pileus epicutis on the margin (10-)19.5-36(-53.5) × (4-)4.5-6.5(-9) µm, mainly cylindrical or clavate, sometimes also capitate, ellipsoid, fusoid or subulate, in terminal part mostly rounded and wider than 3 µm. The terminal cells on the centre of pileus epicutis (9.5-)14.5-25.5(-44) × (4-)4.5-7(-8) µm, mainly cylindrical, rarely also ellipsoid, ovate, clavate, ampullaceous or fusoid, in the terminal part rounded and wider than 3 µm.

Terminal cells of **pileocystidia** (14.5-)28-57.5(-79) × (5.5-)6-10(-13.5) µm, clavate, rarely narrowly ellipsoid or cylindrical, almost all rounder in the terminal part.

Habitat - in submountane to subalpine coniferous forests associated with *Picea*, *Pinus sylvestris* or *Larix* trees, from June to September.

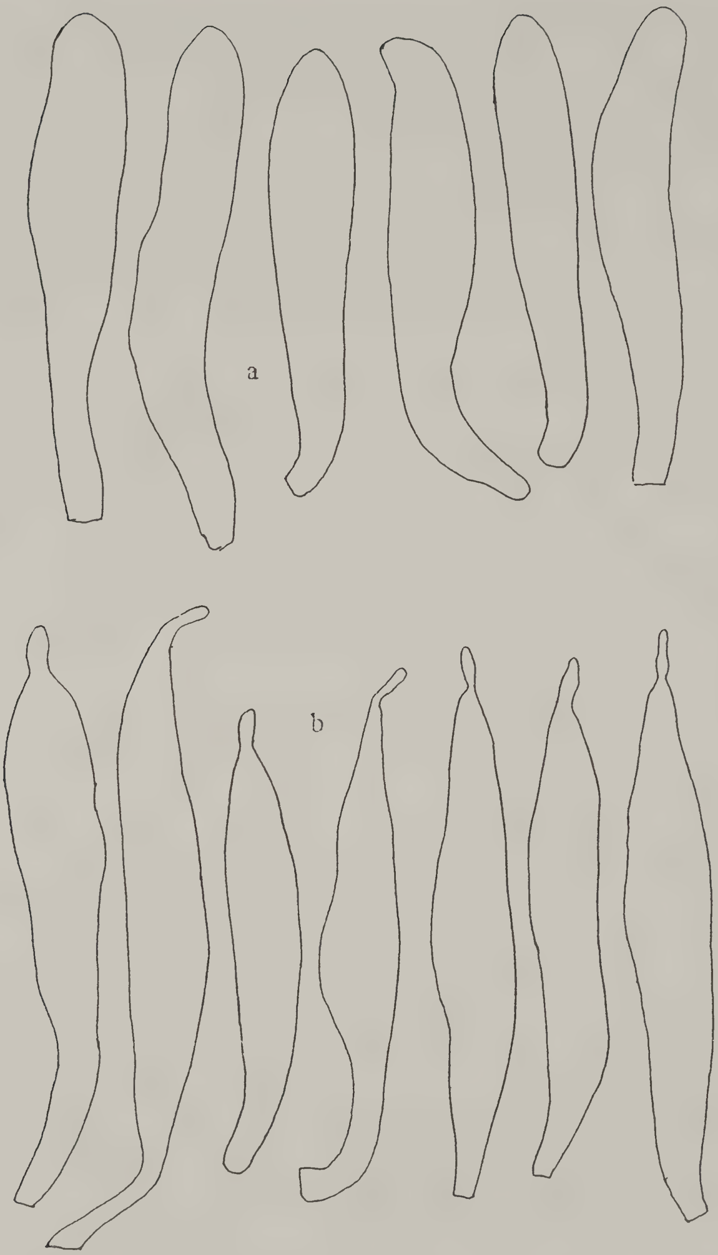

Fig. 5. Pleurocystidia of the type specimen of *Russula xerampelina* (Adamčík, SAV) and *R. erythropoda* (Adamčík, SAV). a. – epitype of *R. xerampelina* (750 ×), b. – neotype of *R. erythropoda* (750 ×).

Specimens examined - **[Slovakia]** [Západné Beskydy] Oravský Podzámok, 15.VIII.1959, Fábry (BRA, *R. xerampelina* var. *pseudomelliolens*) - convexum Turčianska kotlina, in piceto acido in silva "Rovná hora" dicta 2 km situ merid. a pago Dubové (distr. Martin), alt. 520 m, 25.VII.1985, Hagara (BRA). - Mont. Vysoké Tartry [Západné Tatry], prope Podbanské, terr. nat. munitum Machy, in piceto, alt. 900 m, 13.VII.1986, Kuthan (BRA). - Západné Tatry mountains, at Jalovecký potok stream, in the mouth of Jalovecká dolina valley, under *Picea abies*, *Larix decidua*, on the decayed needles among the sparse herbal undergrowth, ca. 730 m a.s.l., 26.VI.1998, Adamčík (SAV). - Západné Tatry mountains, in the firth of Bobrovecká dolina, under *Picea abies*, in the dense herbal undergrowth of *Melampyrum sylvaticum*, *Alchemilla* sp., *Poa* sp. and other plants, ca. 750 m a.s.l., 26.VI.1998, Adamčík (SAV). - Veľká Fatra mountains, Bukovinka hill, under *Picea abies*, on the decayed needles in the sparse herbal undergrowth, 780 m a.s.l., 16.VII.1998, Adamčík (SAV). - Nízke Tatry mountains, on the pasture above Brankovský vodopád falls, under *Picea abies*, in decayed needles, ca. 1000 m a.s.l., 16.VII.1998, Adamčík (SAV). - **[Czech Republic]** Sub *Picea*, Hor. Rokytnice, alt. 1000 m, VIII.1933, Zvára (PRM, 770644). - Protivín ("Háj"), 30.VII.1936, Herink (PRM, 770635, *R. xerampelina* var. *fusca*). - Silva "Farářství" distr. Turnov, picetum ad terram, 12.VIII.1941, Schmidt (PRM, 521391, *R. xerampelina* var. *elaeodes*). - Zátoň, mons "Boubín" (distr. Prachatice), piceto-abieto-fagetum, ad terram, 10.VII.1946, Herink (PRM, 520204, *R. xerampelina* var. *putorina*). - Lenora, osada Zátoň (distr. Moses), "Červený vrch", silv. mix., *Picea exc.*, *Abies alba*, *Pinus sylv.*, *Coryllus avell.*, ad terram, 18.IX.1948, Herink (PRM, 609822, *R. xerampelina* var. *putorina*). - **[France]** Dans les département des Alpes Maritimes, au lieu dit "La Vacherie du Boréon", alt. 1600 m, 25.VII.1981, Trimbach (herb. Trimbach, Nice, no. 2056) - **[Austria]** Ochsenkopf bei Obergurgl, Ötztal, Tirol, Nadelwald (*Pinus cembra* und *Larix*) an grasiger Stelle (Silikatboden), 25.VIII.1975, Moser (IB, 75/95, *R. favrei*)

Russula xerampelina **(Schaeff.) Fr.**, Epicr. Syst. mycol.: 356, 1838., *nom. cons. prop.*

Neotypus (designated here, and proposed as typus conservatus): [Germany] „Oberbayern: Alteichenrevier im Forstenrieder Park a. d. Römer str., MTB 7934, bei randlicher Fichte, 15.IX.1981, Einhellinger" (M, 30-99/8).

≡ *Agaricus xerampelinus* Schaeff., Fung. Bavar. Palat. nasc., Vol. 4: 49-50, 1774. Ind. loc.: [Germany, Bavaria] "Wächst unter den übrigen Täublingen im Herbste in den Wäldern." Original illustration and syntypes to be rejected: Schaeff., Fung. Bavar. Palat. nasc., Vol. 3: Tab. CCXIV, Tab. CCXV, 1771.

= *Russula erythropoda* Peltereau, Bull. Soc. Mycol. France 24: 117, 1908. Ind. loc.: [France] "dans les bois résineux, très tardivement, fin octobre ou novembre". Neotypus (designated here): Slovakia, Nízke Tatry mountains, 1 km S of the margin of the Liptovský Hrádok town, under *Pinus sylvestris* and *Picea abies*, on decayed needles, 775 m a.s.l., 14.X.1998, Adamčík (SAV).

≡ *Russula xerampelina* var. *erythropoda* (Peltereau) Konrad et J. Favre, Bull. Soc. Mycol. France 49: 195, 1933.

= *Russula atrosanguinea* Velenovský, České houby, Vol. 1: 143, 1920. Ind. loc.: [Czech Republic] "V starých smrkových lesích řídce, 7-8. U Mnichovic a Hrusic na více místech, vždy pospolitě. U Radotína blíž cihelny Kosořské". [Typus ignotus, ex descr.]

Misidentifications:

Russula linnaei auct. non Fr.: Ricken, Blätterpilze Deutschl.: 49, 1911; Velen., České houby: 155, 1920.

Russula purpurea auct. non (Schaeff.) Gillet: J. E. Lange, Dansk Bot. Ark. 4 (12): 42-43, 1926.

Russula xerampelina var. *rubra* auct. non (Britzelm.) Singer: Singer, Hedwigia 66: 238, 1926, Jul. Schaeff., Ann. Mycol. 31 (5-6): 373, 1933.

Russula xerampelina var. *linnaei* auct. non (Fr.) Melzer et Zvára: Melzer et Zvára, České holubinky: 59, 1927.

Specimens examined (determined on the level of species) – **[Slovakia]** [Západné Beskydy] Oravský Podzámok, 12.VIII.1960, Fábry (BRA, *R. xerampelina* var. *erythropoda*). - [Záhorská nížina] Plavecký Štvrtok, 13.X.1960, Fábry (BRA, *R. xerampelina*). - [Záhorská nížina] Plavecký Štvrtok, v borovom lese, 19.X.1960, Fábry (BRA, *R. xerampelina*). - [Veľká Fatra] Ľubochňa prope Ružomberok, in silva coniferarum, alt. 500 m, 13.VIII.1967, Kuthan (BRA, *R. xerampelina*). - Záhorská nížina, ad terram in pineto prope pag. Plavecký Štvrtok, 13.X.1973, Horváthová (BRA, *R. xerampelina* var. *erythropoda*). - Záhorská nížina, Jakubov "Feld", ad terram in pineto, 3.IX.1977, Dermeková (BRA, *R. xerampelina*). - Malá Fatra, v smrečine na sev. úbočí vrchu Dubový diel, 1,8 km ZJZ od obce Bystrička, alt. 570 m, 1.X.1982, Hagara (BRA, *R. xerampelina*). - Malá Fatra, smrekovo-borový porast na sev. úbočí vrchu dubový diel (chotárna časť Tŕstie), 1,9 km ZJZ od obce Bystrička, alt. cca. 550 m, 16.X.1982, Hagara (BRA. *R. xerampelina*). - Montes Malá Fatra, in piceto ad pedem collis Hrádok 21,4 km situ occid. a pago Bystrička (distr. Martin), alt. cca. 570 m, 9.X.1984, Hagara (BRA, *R. xerampelina*). - Montes Malá Fatra, sub Piceis in loco "Lazy" dicto cca. 1,5 km situ septent.-occid. a pago Bystrička (distr. Martin), alt. cca. 600 m, 14.X.1984, Tolnay (BRA, *R. xerampelina*). - Montes Malá Fatra, in piceto ad calcem in colle Hrádok 2,4 km situ occid. a pago Bystrička (distr. Martin), alt. cca. 570 m, 15.X.1984, Hagara (BRA, *R. xerampelina*). - Convexum Turčianska kotlina, in piceto acido in silva "Rovná hora" dicto 2 km situ merid. a pago Dubové (distr. Martin), alt. 520 m, 22.VIII.1985, Hagara (BRA, *R. xerampelina*). - [Veľká Fatra] sub piceis in valle "Jasenská dolina" 2,6 km situ merid.-orient. a pago Turčianske Jaseno (distr. Martin), alt. 670 m, 6.IX.1986, Hagara (BRA, *R. xerampelina*). - Borská nížina [Záhorská nížina], 4 km SZ od obce Studienka (okr. Senica), v riedkej brezovej mladine na okraji borovicového lesa, alt. cca. 200 m, 18.X.1987, Sand (BRA, *R. xerampelina*). - Tríbeč, Klátova Nová Ves, časť Sádok, lokalita Kozlica, okraj lesa, pod borovicami a čerešňami, alt. cca. 220 m, 5.X.1996, Benko (BRA, *R. amoenipes*). - **[Czech Republic]** Všenory ad Prag., sub picea et pino, X.1934, Zvára (PRM, 770645, *R. xerampelina* var. *erythropus*). - "Lomec" pr. Vodňany, in pic., 6.VIII.1937, Herink (PRM, 480143, *R. xerampelina*). - Vodňany, in musc. pic. "Kovár", 12.VIII.1937, Herink (PRM, 490096, *R. xerampelina*). - Prachatice, in silva montis Libín, in pic., alt. 1091 m, 24.VIII.1937, Herink (PRM, 489852, *R. xerampelina*). - Praha, Divoká Šárka, in picetis, 7.IX.1937, Herink (PRM, 770637, *R. xerampelina*). - Golčuv Jeníkov, in pic., 7.VIII.1940, Herink (PRM, 770647, *R. xerampelina* var. *linnaei*). - Hřebečníky (distr. Rakovník), in piceto-pinetis, 16.IX.1940, Herink (PRM, 770628, *R. xerampelina* var. *linnaei*). - Hřebečníky (distr. Rakovník), in gram. piceto-quercetis, 16.X.1940, Herink (PRM, 770671, *R. xerampelina* var. *linnaei*). - Dolní Kralovice, in silva conif., 24.VIII.1942, Herink (PRM, 770703, *R. xerampelina* var. *rubra*). - Vodňany, in piceetis, 2.IX.1942, Herink sen. (PRM, 770700, *R. xerampelina* var. *rubra*). - Valdštejn pr. Turnov, in pinetis (cum Quercubus et Fagis), 24.X.1943, Herink (PRM, 770709, *R. xerampelina*). - Hlásná Třebáň (silva "Políčko"), in silvis mixtis (*Pinus sylvestris*, *Quercus*), 26.XI.1944, Svrček (PRM, 770670, *R. xerampelina* var. *erythropoda*). - Valdštejn pr. Turnov, in pineto c. Vaccinio myrt., 19.VIII.1945, Herink (PRM, 770681, *R. xerampelina*). - Klokočí, vallis rivi "Klokočský potok" locus "Rašovka" dictus, distr. Trutnov, picetum, alt. 260 m, 3.IX.1946, Schmidt (PRM, 521417, *R. xerampelina* var. *erythropoda*). - Klokočí, vallis rivi "Klokočský potok" (distr. Trutnov), picetum, alt. 260 m, 9.IX.1946, Schmidt (PRM, 521458, *R. xerampelina* var. *erythropoda*). - Lnáře pr. Blatná, in piceto muscoso ad stationem hydrobiologicam, 20.IX.1946, Svrček (PRM, 770705, *R. xerampelina*). - Čimelice, silva Chlum, in piceto-pineto, 2.VIII.1966, Svrčková (PRM, 626242, *R. xerampelina* var. *erythropus*). - **[Germany]** Potsdam-Ferch, sub pinis, IX.1930, Schaeffer (FH, *R. xerampelina*). - Görlitz, X.1933, Pilát (PRM, 770629, *R. xerampelina* var. *rubra*). - Umgebung vom Augsburg: Horgau, 3.VII.1965, Stangl (M, 30-99/16, *R. xerampelina* var. *rubra*). - Dürnbucher Forst bei Münchsmünster, 26.IX.1969, Einhellinger (M, 30-99/1, *R. xerampelina*). - Eichenrieder Moos bei Eichenried i. Zdkr. Erding, Fichten auf Moorboden, 26.IX.1970, Einhellinger (M, 30-99/4, *R. xerampelina* var. *erythropus*). - Isarau bei Ismaning, Fischerhäuser, 26.IX.1971, Einhellinger (M, 30-99/2, *R. xerampelina*). - Waldkraiburg, im Hart im Fi-Wald, 9.VIII.1973, Marschner (M, 30-99/12, *R. xerampelina*). - Eichenreider Moos bei Eichenreid im Erdinger Moor, cca. 20km nordöstl. von München, Fichtenwald auf ehemaliger Abtoobringsfeuche, 15.VIII.1974, Einhellinger (M, 30-99/14, *R. xerampelina*). - Dürnbucher Forst bei Siegenburg i. d. Hallertau, MTB 7236, im flechtenr. sandigen Kiefernforst, 5.X.1980, Einhellinger (M, 30-99/7, *R. xerampelina*). - Alteichenrevier östl. bauting i. Forstenrieder Park a. d. Römer str., MTB 7934, aber aud. Grenze zum Fichtenwand, 28.X.1980, Einhellinger (M, 30-99/9, *R. xerampelina*). - Alteichenrevier im Forstenrieder Park a. d. Römer str., MTB 7934, bei randlicher Fichte, 15.IX.1981, Einhellinger (M, 30-99/8, *R. xerampelina*). - LSG Siegenburg, sandigen, flechtenreichen Kiefernwald, MTB 7236, 6.XI.1982, Einhellinger (M, 30-99/10, *R. xerampelina*). - Isarhochunterwald a. d. Isar, bei Fichten, 21.IX.1984, Einhellinger (M, 30-99/11). - Umgebung von Augsburg, Stangl (M, 30-99/5, *R. xerampelina* var. *erythropus*).

Russula xerampelina var. *xerampelina*

(Fig. 5.b, 6.)

Pileus (3.7-)5.3-9.5(-10.7) cm diam., convex when young, soon expanded plane and slightly depressed in the centre, often infundibuliform with age, mainly regularly shaped and often lobate, margin obtuse, striated to 0-9 mm from the margin to the centre, cuticle separable to 7-23 mm, from the margin. Cuticle on the margin bright purple-red and only rarely spotted, towards the centre dark purple, purple-black to black, sometimes with small brown, olive to ochraceous spots. Surface of the cuticle mat on the margin or to the half of pileus radius, in the centre shining, in the middle zone rough and wrinkled, in the centre rough, smooth or rarely scrobiculated. The pigment trace on the wet filter paper after chaffing on pileus cuticle is rose to rose-vinaceous, very rarely also rose brown. Pileus cuticle in some fruitbodies growing in dry condition has more violet colour and surface mat to almost pruinose.

Stipe (2.4-)4-7.8(-9.6) cm long, (1.2-)1.5-3 cm thick, often eccentric, cylindrical or clavate, surface strongly longitudinal striate, the majority of surface is covered by rose to carmine-red colour, turning rusty-colour after bruising, cortex 1.5-3.5(-4) mm thick.

Hymenium with (138-)141-202(-234) lamellae, 2-9 lamellulae (1-7 lamellulae longer than half of length of lamellae) and 3-15 furked lamellae. Lamellae (3.5-)4.5-12(-13) mm wide, cream colour to pale ochraceous, with yellow tint in frontal view, adnexed.

Flesh compact, white, turning minutely yellow in cortex of stipe and turning rusty-brown in medulla and pileus, in the half of pileus radius (2.5-)3.5-6.5 mm thick. Smell obscure in fresh condition, crab-like when drying of damping off. Reaction to $FeSO_4$ grey-green when young, than less intensive and more with ochraceous tint.

Colour of **spore print** ochraceous to pale yellow (IIIc-IVa according to ROMAGNESI, 1967).

Basidia (35.5-)37.5-60.5(-65.5) × (10.5-)11.5-14(-15.5) µm.

Pleurocystidia (70-)78-105.5(-114.5) × (10.5-)11-15(-16.5) µm, almost all with 1-17.5 (-23.5) µm long appendage, mostly constricted and acute in terminal part.

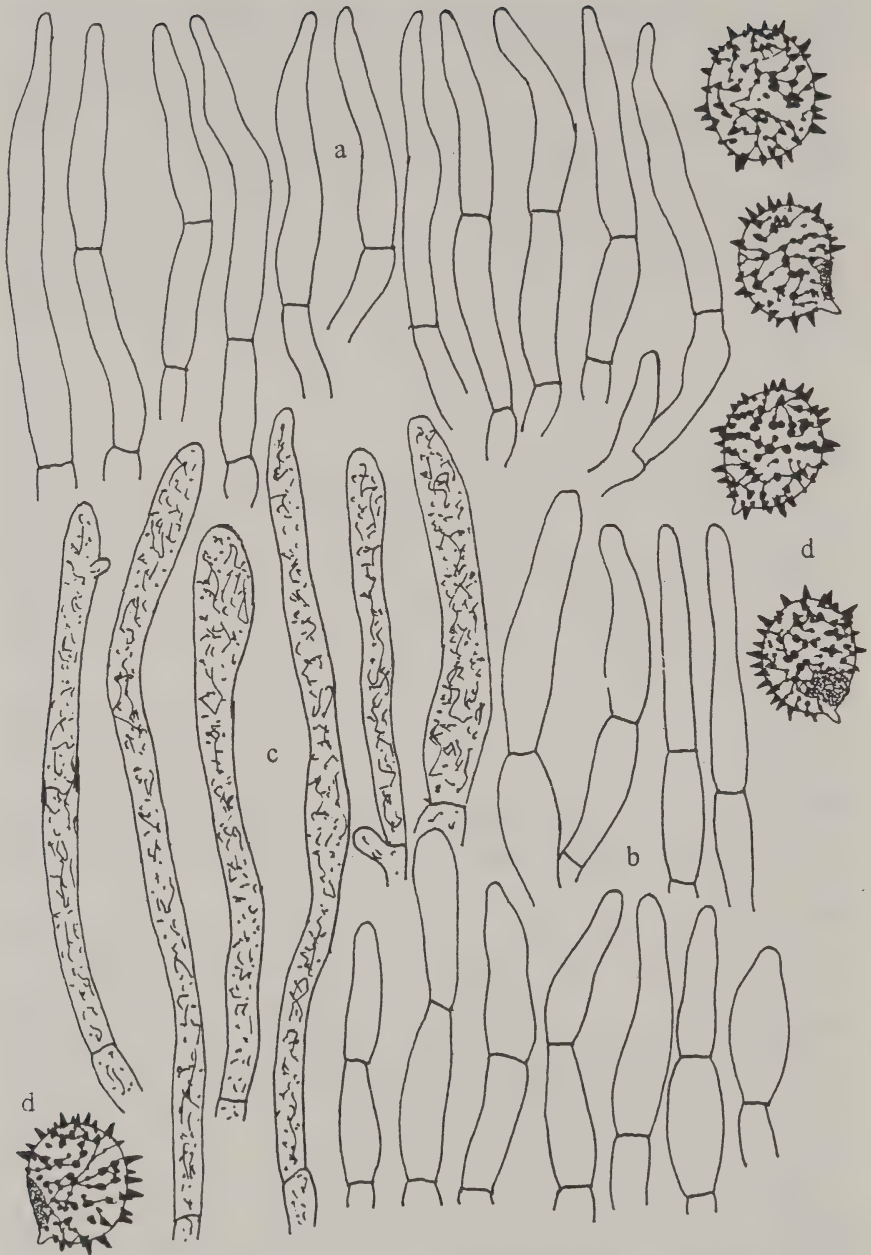

Fig. 6. Microscopic structure of neotype of the name *Russula erythropoda* (Adamčík, SAV). a. – generative hyphae on the margin of pileus epicutis (1000 ×), b. – generative hyphae on the centre of pileus epicutis (1000 ×), c. – pileocystidia (1000 ×), d. – spores (1600 ×).

Spores (8.2-)8.8-9.9(-10.6) × (6.3-)6.9-7.8(8.2) µm, Q = 1.23-1.33, spines (0.6-)0.8-1(-1.2) µm long and numerous - (5-)5.5-9(-11) in the circle of diameter of 3 µm, amyloid punctation middle distant - (0-)2-4.5(-10) in the circle, line connection frequent - (0-)2-5(-8) in the circle, contact connections numerous - (3-)3.5-8(-11) in the circle. The spines are only rarely isolated.

Terminal cells of **generative hyphae** on pileus epicutis on the margin (19-)24.5-44(-57) × (3-) 3.5-5.5 (-6) µm, mainly subulate or attenuate, rarely cylindrical of fusoid, often with lateral nodules, almost all narrower than 3 µm in terminal part. The terminal cells on the centre of pileus epicutis (13.5-)21-31.5(-42) × 3-6 (-9) µm, with very various shape: cylindrical, fusoid, attenuate, subulate, ampullaceous, rarely also clavate or ellipsoid, frequently narrower than 3 µm in the terminal part. The second cell of generative hyphae on the centre is often inflated and wider than the terminal cell.

Terminal cells of **pileocystidia** (19-) 30-68 (-93.5) × (4-)4.5-7.5(-8.5) µm, mainly cylindrical, often also clavate, fusoid, attenuate, very slender, often irregularly inflated, acute and rarely rounded or with appendage in the terminal part, often with lateral nodules.

Habitat - coniferous forest in colline to submountane zone, associated with *Pinus sylvestris* and *Picea* trees, growing in September to November.

Specimens examined - **[Slovakia]** Nízke Beskydy mountains, Ondavská vrchovina hills, 2 km E of Kvakovce village, under *Pinus sylvestris*, on the ground without herbal undergrowth, 200 m a.s.l., 7.X.1998, Adamčík (SAV). - Nízke Tatry mountains, 1 km S of the margin of the Liptovský Hrádok town, under *Pinus sylvestris* and *Picea abies*, on decayed needles, 775 m a.s.l., 14.X.1998, Adamčík (SAV). - Nízke Tatry mountains, in the valley 1 km SSW the town of Liptovský Hrádok, under *Picea abies*, in decayed needles and among grass, 725 m a.s.l., 14.X.1998, Adamčík (SAV). - Liptovská kotlina , 1 km S of Východná village, on the right side of river Váh, under *Picea abies*, among moses, 860 m a.s.l., 15.X.1998, Adamčík (SAV). **[Italy]** Trento region, "Kieselreck" near Pergine Valsugana, under *Picea* and *Larix*, 1300 m a.s.l., 24.IX.1997, Adamčík and Floriani (SAV).

Russula xerampelina **var.** ***tenuicarnosa*** **var. nova**

(Fig. 7.)

Diagnosis:

A typo differt carne versus medium pilei radium 2-3 mm crassa, pileo versus marginem manifeste striato (3-12 mm), stipite angustissimo, 1,3-1,9 (-2,3) cm crasso et lamellis minus numerosis (99-162).

Holotypus: Záhorská nížina lowland, between Tomky village and Červený rybník lake, 5 km W of Lakšárska Nová Ves village, on the sandy soil, among mosses and grass on the margin of the path, under *Pinus sylvestris*, 200 m a.s.l., 30.IX.1998, Adamčík (SAV).

Pileus (4.8-)5.7-7.3(-8.2) cm diam., soon expanded plane and slightly depressed in the centre, then infundibuliform, often irregularly shaped and lobate, margin obtuse, striated to 3-12 mm from the margin to the centre, cuticle separable to 8-27(-30) mm from the margin. Colour of pileus cuticle similar to the type variety. Surface of pileus cuticle wrinkled or rough in the middle zone and rough or obscurely

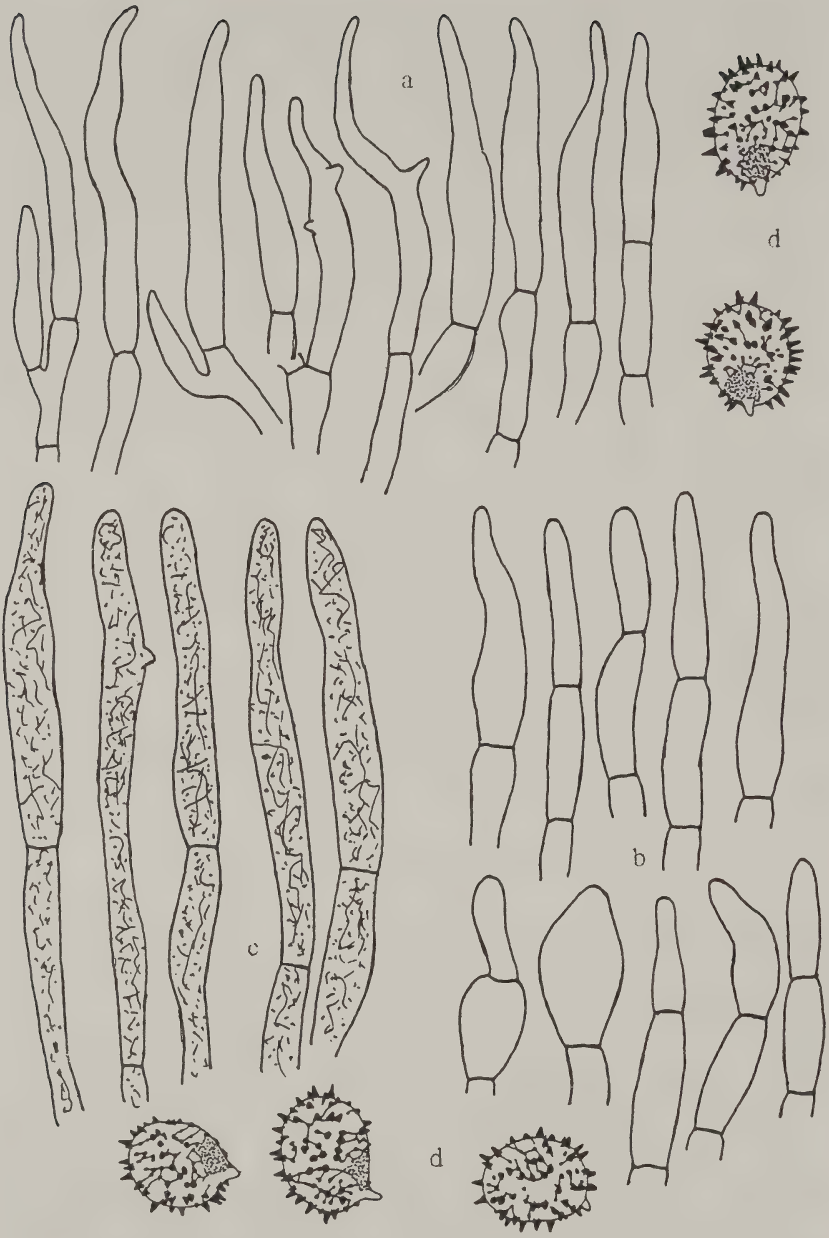

Fig. 7. Microscopic structure of holotype of the name *Russula erythropoda* var. *tenuicarnosa* (Adamčík, SAV). a. – generative hyphae on the margin of pileus epicutis (1000 ×), b. – generative hyphae on the centre of pileus epicutis (1000 ×), c. – pileocystidia (1000 ×), d. – spores (1600 ×).

scrobiculated in the centre. The pigment trace on the wet filter paper after chaffing on the pileus cuticle rose.

Stipe 4.9-9 cm long, 1.3-1.9(-2.3) cm thick, often eccentric, cylindrical, surface distinctly longitudinal striate, majority of surface is covered by rose to carmine colour, turning rusty colour after bruising, cortex (1-)1.5-2 mm thick.

Hymenium with (79-)99-162 lamellae, 1-5 lamellulae (0-5 lamellulae longer than half of length of lamellae), 0-8 furked lamellae. Lamellae 5-12 mm wide, cream colour to pale ochraceous, bright yellow in frontal view, adnexed.

Flesh compact, then fragile, 2-3.5 mm thick in the half of pileus radius. Smell, reaction to $FeSO_4$ and changing of colour after bruising as in type variety.

Colour of **spore print** ochraceous (IIIc according to ROMAGNESI, 1967).

Basidia (35.5-)36.5-47.5(-53.5) × (10.5-)11.5-14.5(-15.5) µm.

Pleurocystidia (63.5-)77-92(-124.5) × (11-)12-13(-15.5) µm, almost all with 1-7.5(-17) µm long appendage, mostly constricted and acute in the terminal part.

Spores (7.3-)7.9-9.5(-10.5) × (5.9-)6.4-7.5(-8.2) µm, Q = 1.2-1.29, spines (0.7-)0.8-1.1(-1.2) µm long and numerous - (4-)6-9(-11) in the circle of diameter of 3 µm, amyloid punctation medium distant - (0-)2-4.5(-7) in the circle, line connections frequent - (0-)1-3.5(-6) in the circle, contact connections also frequent - (3-)3.5-8(-11) in the circle.

Terminal cells of **generative hyphae** on pileus epicutis on the margin (17-)22-49(-66) × (3-)4-5(-5.5) µm, subulate, attenuate, ampullaceous or fusoid, rarely cylindrical or clavate, almost all narrower than 3 µm in the terminal part, sometimes with lateral nodules. The terminal cells on the centre of pileus epicutis (13.5-)18-28.5(-44) × (3-)3.5-5(-8) µm, mostly cylindrical, rarely subulate, ampullaceous or clavate, often narrower than 3 µm in the terminal part.

Terminal cells of **pileocystidia** (26-)31-69.5(-108.5) × (4-)5-7(-8) µm, mainly cylindrical, often clavate or fusoid, rounded or acute in the terminal part, frequently irregularly inflated.

Habitat - on the sandy soil under *Pinus sylvestris*.

Specimens examined - **[Slovakia]** Záhorská nížina lowland, between Tomky village and Červený rybník lake, 5 km W of Lakšárska Nová Ves village, on the sandy soil, among mosses and grass on the margin of the path, under *Pinus sylvestris*, 200 m a.s.l., 30.IX.1998, Adamčík (SAV). - Záhorská nížina lowland, Červený rybník lake, 3 km W of Lakšárska Nová Ves village, on the sandy soil, among mosses, under *Pinus sylvestris*, 200 m a.s.l., 30.IX.1998, Adamčík (SAV). - **[Italy]** Trento region, Langhestel near Pine, under *Pinus sylvestris* on acid soil, 900 m a.s.l., 25.IX.1997, Adamčík and Floriani (SAV).

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MYCOTAXON

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NEW SPECIES OF OUDEMANSIELLA AND POUZARELLA (BASIDIOMYCETES: AGARICALES) FROM PUERTO RICO

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ABSTRACT: *Oudemansiella fibrillosa* and *Pouzarella caribaea* are described as new from the Guilarte National Forest Preserve in Puerto Rico.

KEY WORDS: Entolomataceae, Greater Antilles, Tricholomataceae

INTRODUCTION

Over the past decade several papers have been published on members of Agaricales from Puerto Rico (Baroni and Lodge, 1998; Baroni et al., 1999; Cantrell and Lodge, 2000 & 2001; Guzmán, et al., 1997; Lodge, 1988; Lodge et al., 2001; Lodge and Pegler, 1990; Miller et al., 2000; Pegler, et al., 1998; Singer and Lodge, 1988. Much of the previous literature discussing publications on agarics for Puerto Rico can be found in Baroni and Lodge (1998) and Lodge (1996).

A recent study by one of us (BO) on the agaric mycota in the Guilarte State Forest, a wet subtropical forest located in the Cordillera Central of southwestern Puerto Rico (18º07N, 66º27W), has turned up two new species of agarics. Previously Bor (1969) had reported only nine species total from the Guilarte State Forest in Puerto Rico. We now have documented an additional 14 species, which includes the two new taxa described below. However, many collections from the Guilarte State Forest have yet to be identified to species, and thus this number will continue to rise.

The main collecting area was the Monte Guilarte Peak trail between 1000 and 1205 m elevation. The trail flora is mainly composed of *Prestoea montana* (R. Grah.) Nichols, *Micropholis chrysophylloides* Pierre, *Buchenavia capitata* (Vahl) Eichl. and *Cyathea arborea* (L.) J. E. Smith.

MATERIALS AND METHODS

Collection and preparation of fresh specimens by B. Ortiz for later study followed standard technique. Color names are given as general hues and were not matched to color references. Measurements of microscopic structures were made in 3% KOH or 10% NH_4OH unless otherwise noted. In the description of the basidiospores, n = 30 indicates that a total of 30 spores were measured; L^m = mean length; W^m = mean width; Q = length/width of individual spores and is given as a range; Q^m = the mean of all Q values in a sample. Basidiospores were measured with an Olympus BHS light microscope under a 100x Hoffman interference lens using a semi-automated image analysis system (a GTCO digitizer pad and Metrics5 software written by Dr. David Malloch). Descriptive statistical analysis of the measurements was obtained using EXCEL 5.0. All scanning electron micrographs were made on an ISI Supra IIIA scanning electron microscope generally run at 10 Kev. Methods for preparation of samples for SEM are those of Baroni (1981). All line drawings of microscopic structures were made with the aid of a drawing tube.

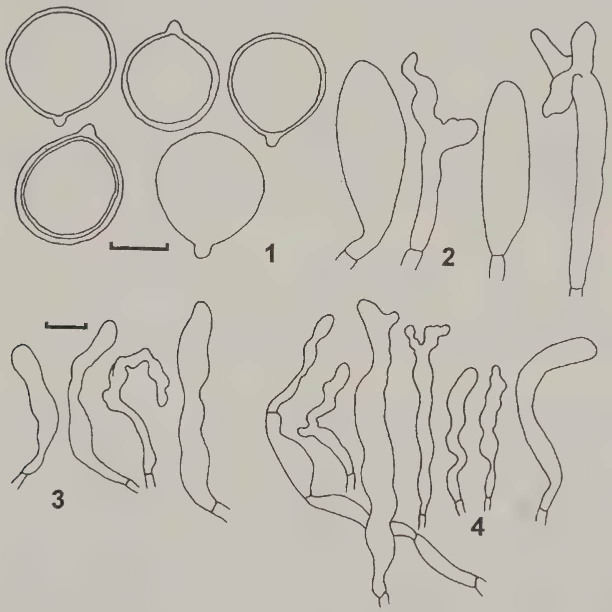
DESCRIPTIONS

Oudemansiella fibrillosa T. J. Baroni & B. Ortiz, sp. nov.

Figs. 1-10

Pileus flavido- vel roseo-bruneus, 22-44 mm latus, convexus; discus fusco-brunneus, squamis tenuifibrillosis brunneis supra discum atque marginem versus adspersis praeditus. Lamellae pallide subroseo-bubalinae adnatae, dente brevi vel brevi-decurrentes, aggregatae. Stipes super apicem pallide subroseo-bubalinus, basem versus brunnescens, ad basem paene fuscus, ad apicem 3-5 mm latus, 20-35 mm longus, aequus vel subclavatus, infra annulum superiorem fibrillosum evanescentem fibrillis implexis obtectus. Basidiosporae 13.8-21.5 x 12.8-20.3 μm, Q = 1.06, globosae vel subglobosae, crassitunicatae (0.8-2.4 μm), laeves. Cheilocystidia anguste ventricosa, alia apicibus contortis vel cylindrice contortis atque alia apicibus ramuloso-contortis praedita. Pleurocystidia ventricosa vel late ventricoso-rostrata, maximam partem parietibus crassis refractivis 120-250 x 21-60 μm. Pileipellis e hyphis gelatinis 2-4.8 μm diametro atque hyphis non gelatinis inflatis 7-26 μm diametro immixtis composita; hyphae inflatae pilocystidia clavata late ventricosa vel contorta cylindrica 52-162 x 8-26 μm producentes. Fibulae nullae.

Pileus (Fig. 6) yellowish brown or pinkish brown with a darker brown disc, developing more yellow hues upon expansion, with fine fibrillose brown scales on the disc, these fine scales becoming sparse and more scattered toward the margin, 22-44 mm broad, convex becoming plano-convex and slightly depressed over the disc, smooth, margin finely striate and translucent-striate, crenulate around the edge. ***Lamellae*** pale pinkish buff, adnate with a decurrent tooth or short decurrent with expansion, crowded, with 2 tiers of lamellulae, 3-5 mm broad, irregularly serrate on margin. ***Stipe*** pale pinkish buff over apex, becoming progressively darker brown toward base, deep dark brown or nearly fuscous at very base, 3-5 mm broad at the apex, 20-35 mm long, equal or subclavate, covered with matted fibrils below an evanescent fibrillose, superior annular ring, hollow with age. ***Basidiospores*** (Figs. 1 and 11-12) 13.8-21.5 x 12.8-20.3 μm (n = 30, L^m = 17.5, W^m = 16.5, Q = .98-1.15, Q^m = 1.06), globose or subglobose, ± hyaline, inamyloid, thick walled (0.8-2.4 μm) with two or three layers, thin outer wall distinctly cyanophilic, inner walls hyaline in all reagents, smooth, with large rounded apiculus, 1.6-2.4 μm long and 2.4 μm wide, filled with refractive droplets. ***Basidia*** (2-) 4-sterigmate, clavate, filled with refractive droplets, cyanophilic bodies absent, 54-74 x 20-24 μm.



Figs. 1-4. *Oudemansiella fibrillosa* (all from HOLOTYPE): Fig. 1 Basidiospores. Fig. 2. Pilocystidia. Fig. 3 Caulocystidia. Fig. 4 Cheilocystidia. Scale bar for Fig. 1 = 10 μm. Scale bar for Figs. 2-4 = 20 μm.

Lamella trama hyaline, of parallel or somewhat interwoven, cylindric or slightly inflated, thin-walled, often subgelatinized hyphae, 4-16 μm in diam, at the edges extending into a long projecting (100-200 μm beyond the flanking basidia near the edge), sterile column-like layer of hyaline, thin-walled, closely packed, gelatinized or subgelatinized hyphal cells with ***Cheilocystidia*** (Fig. 4) densely packed at their tips, cheilocystidia narrowly ventricose or narrowly clavate or cylindrical or of various other shapes, not infrequently also with contorted or

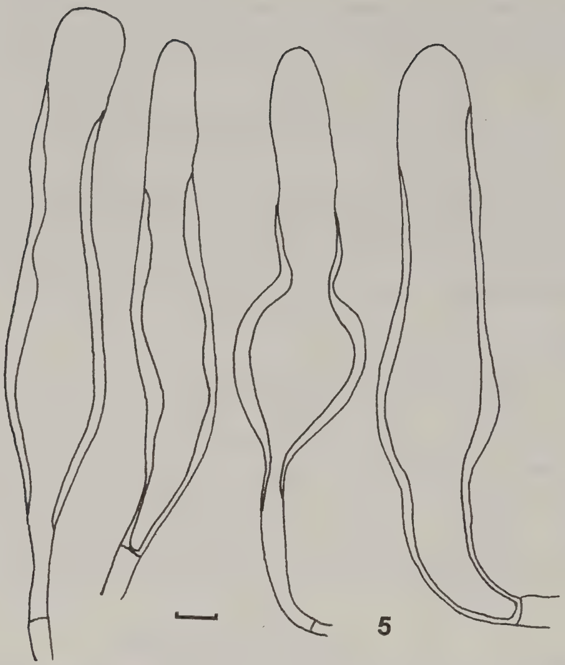


Fig. 5. *Oudemansiella fibrillosa* (HOLOTYPE). Pleurocystidia. Scale bar = 20 µm.

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branched and contorted apices, 54-150 x 6-16 µm. ***Pleurocystidia*** (Fig. 5) projecting 50-175 µm beyond basidia, abundant, hyaline, ventricose or broadly ventricose-rostrate, mostly with thick refractive walls (1.6-2.4 µm) except for apex and very base which remain thin-walled, 120-250 x 21-60 µm. ***Pileus context*** hyaline, composed of interwoven, cylindric or inflated, thin walled hyphae, 6.4-24 µm in diam. ***Pileipellis*** (Fig. 7) a dull brown layer in 3% KOH, 200 µm or more thick, ± a disrupted hymeniform layer, composed of loosely entangled, cylindric, gelatinized hyphae, 2-4.8 µm in diam, intermixed with inflated hyphae, 7-26 µm in diam, these inflated hyphae producing clavate, broadly ventricose or occasionally branched or contorted cylindrical pilocystidiate end cells (Fig. 2), 52-162 x 8-26 µm, which appear hyaline or more often filled with abundant dark brown plasmatic pigment. ***Stipitipellis*** a hyaline or pale melleous layer of repent, parallel, cylindric hyphae, 4-8 µm in diam, producing single or scattered clusters of erect, thin-walled caulocystidia (Fig. 3), 60-100 x 10-12 µm, similar in shape to cheilocystidia. ***Stipe context*** at apex and base, similar to *O. canarii*, monomitic, not obviously sarcodimitic (but see Redhead, 1987). ***Clamp connections*** absent.

Gregarious or subcaespitose on decayed downed log. October.

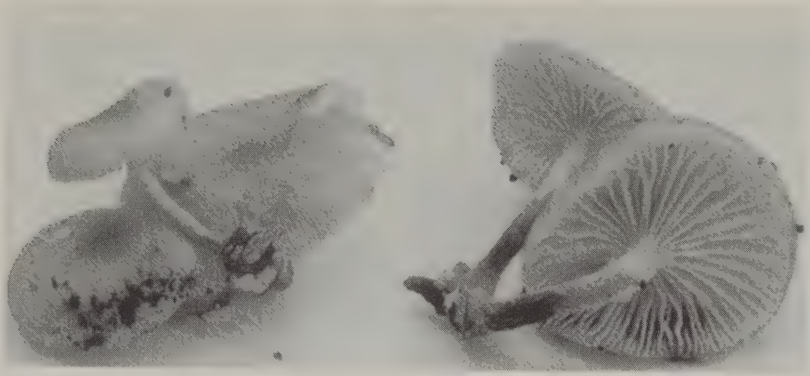


Fig. 6. *Oudemansiella fibrillosa* (HOLOTYPE). Top and bottom views of basidiomata. approx. 1X.

Material examined: PUERTO RICO: Adjuntas, Guilarte State Forest. Beside main trail to the Monte Guilarte Peak, 1100 m, among *Cyathea arborea*, *Prestoea montana*, and *Cecropia schreberiana*, 21 October 1995, B. Ortiz #28 (BOS #28) (**MAPR, HOLOTYPE**).

Additional material examined: ARGENTINA: Palermo, October 1880, C. Spegazzini, type of *Oudemansiella platensis* (Speg.) Speg. (LPS, HOLOTYPE). UNITED STATES: Florida, Alachua Co., vicinity of Gainesville, San Felasco Hammock State Preserve, 19 August 1996, 8083 T. J. Baroni (CORT).

Commentary: *Oudemansiella fibrillosa* is recognized by the very large, globose, smooth, thick-walled, cyanophilic, hyaline basidiospores, the conspicuous thick-walled pleurocystidia, and the gelatinized lamella edges that bear profuse cheilocystidia. At first glance the macromorphological characters of this species remind one of an *Armillaria*. Such features as the lignicolous basidiomata, the finely scattered fibrils on the pileus surface, the fibrillose annulus on a fibrous-tough stipe which is progressively darker colored toward the caespitose bases, the adnate to short decurrent lamellae, and the pale colored basidiospores are all typical characters found in many *Armillaria* taxa. In fact we first thought this was an undescribed species of *Armillaria* and in the past other species now considered to be *Oudemansiella* have been mistaken for *Armillaria* (Volk and Burdsal, 1995). However, the unusual combination of micromorphological features found in *Oudemansiella fibrillosa*, such as the large, globose, smooth, thick-walled basidiospores, the very large projecting pleurocystidia and the distinctive disrupted hymeniform pileipellis readily distinguishes *Oudemansiella fibrillosa* from *Armillaria.*

Under the light microscope the basidiospore wall is very thick and multiple layered (Fig. 1). It appears the outer basidiospore wall becomes more loosely attached as the basidiospores mature (compare Figs. 9 and 10), thus when the basidiospores are placed under the vacuum of a scanning electron microscope, this outer wall layer wrinkles. Such wrinkling is not obvious under the light microscope. This wrinkling of the outer basidiospore wall with maturity

(Fig. 10) for *O. fibrillosa* is similar to the textured basidiospore surfaces found in *Oudemansiella* and *Xerula* (Pegler and Young, 1986; Singer, 1986).

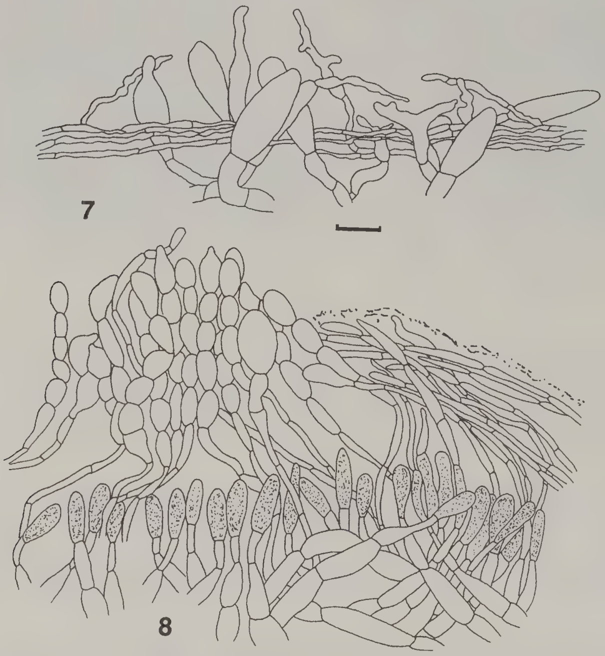
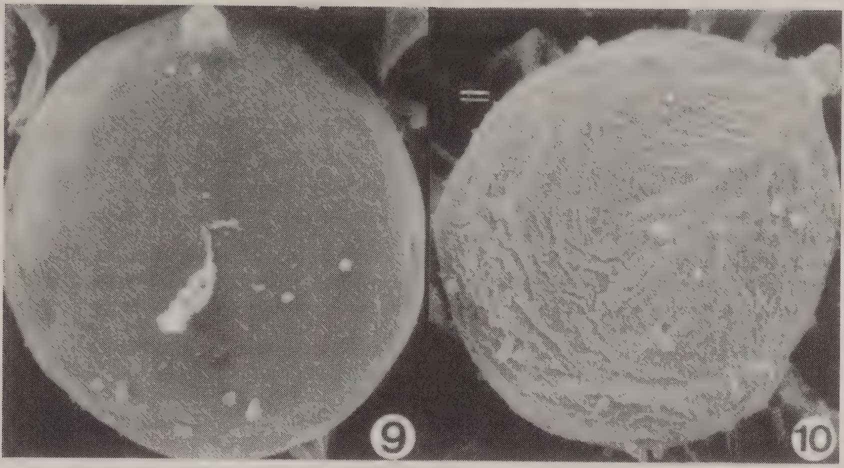


Fig. 7. *Oudemansiella fibrillosa* (HOLOTYPE), pileipellis. Fig. 8. *Oudemansiella canarii,* T. J. Baroni 8083, pileipellis. Scale bar = 20 µm.

Comparing the recent literature on *Oudemansiella* (Pegler and Young, 1986; Singer, 1986; Yang and Zang, 1993) it is clear that *O. fibrillosa* belongs in Subgenus *Oudemansiella* Section *Oudemansiella*. From *O. canarii* it differs by lacking the wart-like brownish plaques or squamules on the pileus, by possessing appressed brown fibrillose scales on the pileus, by producing cylindric, ventricose or narrowly clavate thin-walled cheilocystidia from a gelatinized lamella edge, and by the less complex pileipellis construction (compare Fig. 7 and Fig. 8). Several other additional features further differentiate *O. canarii* and *O. fibrillosa*. The pleurocystidia in *O. fibrillosa* can range up to 250µm in length versus the 180 µm reported for *O. canarii* (Pegler, 1983), and the pleurocystidia for *O. fibrillosa* are strikingly more thick-walled. *O. fibrillosa* lacks clamp connections while *O. canarii* has clamp connections. *O. yunnanensis* Z. L. Yang and Zang, from southwest China (Yang and Zang, 1993), has a white, glabrous, viscid pileus and much larger basidiospores, 24-38 x 23-33 µm. *O. australis* Stev. and G. Taylor, from New Zealand, also has a white pileus, rugulose and intervenose lamellae, and is terrestrial with a subterranean pseudorhiza which indicates this taxon is most likely a *Xerula*.



Figs. 9-10. *Oudemansiella fibrillosa* (HOLOTYPE). 9. Young basidiospore with smooth outer wall layer. 10. Older, mature basidiospore with wrinkled outer spore wall layer. Scale bars = 1 μm.

O. canarii, the most common pantropical species of *Oudemansiella*, has a large number of synonyms (Dennis, 1952; Pegler, 1983; Singer, 1986), but none of these appear to match *O. fibrillosa* (also see the detailed account of Dennis, 1952). The illustration of the pileipellis of *O. platensis* (Speg.) Speg. (= *O. canarii* fide Horak, 1968) is somewhat similar to that presented here for *O. fibrillosa* (Fig. 7), but *O. platensis* lacks fibrils on the pileus surface, lacks cheilocystidia and lacks a gelatinized lamella edge (Spegazzini, 1881; Horak, 1968). Since Horak (1968) did not actually study the type collection of *O. platensis*, an examination of the type of *O. platensis* was conducted to try to determine the make-up of the pileipellis and the anatomical structure of the lamella edge. Unfortunately, the tissues would not revive sufficiently to make such observations, and contaminant hyphae were also present obscuring details.

The anatomical structure of the pileipellis of *O. canarii,* as described by Singer (1945), Dennis (1952), and Pegler (1977 and 1983), needs some further descriptive information, clarification, and illustration, which we provide here from a study of collection TJB 8083 made in Florida. The pileipellis of *O. canarii* is complex and three layered. The suprapellis, which makes up the velar squamules, is composed of globose to pyriform chains of cells (a polycystoderm). The mediopellis is a thick layer of cylindrical, mostly gelatinized, loosely interwoven and ascendant hyphae embedded in a gelatinous matrix. Finally the subpellis is composed of an even or disrupted hymeniform layer of clavate cells with pale brown, plasmatic pigment (Fig. 8). The cells forming the subpellis can collapse and then this layer is difficult to demonstrate. This highly complex structure of the pileipellis for *O. canarii* is distinctive and therefore should be useful when trying to identify or confirm dried material.

Pouzarella caribaea T. J. Baroni and B. Ortiz, sp. nov.

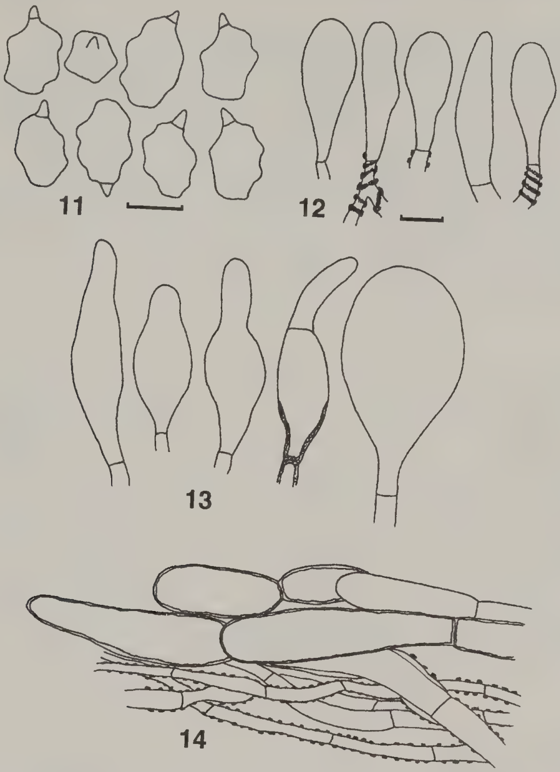
Figs. 11-14

Pileus brunneolo-griseus, 5-11 mm latus, ubique pubescens vel tomentosus; margo translucens striatus. Lamellae brunneolo-griseae, adnatae vel dente decurrenti adnatae, distantes. Stipes brunneus vel brunneolo-griseus, ad apicem 1-3 mm latus, 20-26 mm longus, aequus, ubique pubescens, ad basem strigosus. Basidiosporae 12.5-16.5 x 8.3-11.3 μm, Q=1.48, angulatae, 6-8 prismaticae. Basidia (2-)4-sterigmatophora; basidia "abortiva" abundantia pigmento fuscato-bruneo impleta. Trama lamellaris fuscato-brunnea, e hyphis parallelis cylindricis valde resinosis encrustatis composita. Cheilocystidia plerumque inflata, clavata 20-68 x 12-22 μm; parietes vivide brunnei incrassati pigmentosi. Pleurocystidia ignota. Pileipellis brunnea, plerumque repens atque cellulis ultimis elevatis praedita, prope discum gradatim trichodermium formans, cellulis ultimis (pilocystidiis) atque cellulis sustinentibus inflatis, fuscissimo-brunneis valde pigmento encrustatis, 50-86 x 16-30 μm praedita, cellulis inflatis in subpelle carens. Stipitipellis brunnea, e hyphis fusco-brunneis encrustatis cylindricis 3.2-7.2 μm diametro composita, parietibus brunneis per pigmentum intraparietale praedita, cystidia ventricosa vel ventricoso-rostrata vel late clavata vel cylindrica 54-102 x 14-54 μm. Fibulae nullae.

Pileus brownish gray, 5-11 mm broad, conic, pubescent or tomentose overall, margin translucent-striate, becoming rimose. ***Lamellae*** brownish gray, adnate or adnate with a decurrent tooth, distant, with 2-3 tiers of lamellulae, 1-2 mm broad, serrate on margin. ***Stipe*** brown or brownish gray, 1-3 mm broad at apex, 20-26 mm long, equal, pubescent overall, with strigose base, hollow. ***Basidiospores*** (Fig. 11) 12.5-16.5 x 8.3-11.3 μm (n = 31, $L^m = 14.8 \pm 0.92$, $W^m = 9.96 \pm 0.70$, Q = 1.26-1.65, $Q^m = 1.48$), strongly angled in profile and face views with 6-8 facets, angled in polar view with 5 facets, walls non-reactive in Melzer's reagent, cyanophilic. ***Basidia*** (2-) 4-sterigmate, subclavate or clavate, 50-60 x 14-20 μm, with abundant "aborted" basidia filled with dark brown pigment. ***Lamella trama*** dark brown, of parallel, cylindric, heavily resinous encrusted hyphae, 4-8 μm in diam, subhymenium pseudoparenchymatous. ***Cheilocystidia*** (Fig. 12) abundant, forming a sterile edge, mostly inflated clavate, with deep brown pigmented walls which are very slightly thickened, 40-68 x 12-22 μm. ***Pleurocystidia*** absent. ***Pileus context*** dark brown, composed of interwoven, cylindric, heavily dark brown encrusted hyphae. ***Pileipellis*** (Fig. 14) brown, mostly repent, but with some end cells upturned and inflated forming pilocystidia, making a transition to a trichoderm near the disc, pilocystidia and supporting cells inflated, thin-walled, pale brown near margin, with thick walls near middle and disc, most cells very dark brown and heavily pigment encrusted, 50-86 x 16-30 μm, subpellis/context composed of cylindrical, encrusted hyphae, inflated cells not present. ***Stipitipellis*** brownish layer of repent, dark brown encrusted, cylindrical hyphae, 3.2-7.2 μm in diam, walls also brownish from intraparietal pigment, producing abundant, single or clustered, thin-walled or walls somewhat thickened over basal area, pale brown (intraparietal pigment) caulocystidia (Fig. 13), 54-102 x 14-54 μm, typically ventricose or broadly ventricose or ventricose-rostrate, some broadly clavate, some cylindrical, occasionally with a septum at base of rostrum. ***Clamp connections*** absent.

Gregarious on soil. October.

Material examined: Puerto Rico: Adjuntas, Guilarte State Forest. On bare soil, under the first rest stop lean-to on the main trail to the Monte Guilarte Peak. 1062 m, October, 1995, B. Ortiz #37 (BOS #37) (**MAPR, HOLOTYPE**).



Figs. 11-14. *Pouzarella caribaea* (HOLOTYPE). Fig. 11. Basidiospores. Fig. 12 Cheilocystidia. Fig. 13. Caulocystidia. Fig. 14. Pileipellis. Scale bar for Fig. 11 = 10 μm, scale bar for Figs. 12-14 = 20 μm.

Commentary: This species belongs in Section *Dysthales*, Subsection *Dysthales* of *Pouzarella* sensu Mazzer (1976) because of its tomentose pileus surface and thin-walled, non-setiform caulocystidia. *Pouzarella caribaea* appears most phenetically similar to *P. dysthales* and *Entoloma dysthaloides* Noordeloos. *P. caribaea* differs from *P. dysthales* by shorter basidiospores with a smaller Q value, by the larger, mostly ventricose shaped caulocystidia, and by the differently shaped cheilocysitidia. The basidiospores in *P. dysthales* range from (13.5-)14-19.5(-21.5) x (7.4-)7.9-10.3 (-11) μm, with a Q of (1.5-)1.6-1.8-2.1, while the basidiospores of *P. caribaea* are 12.5-16.5 x 8.3-11.3 μm with a Q of 1.26-1.65. The caulocystidia in *P. dysthales* at the apex of the stipe are 20-55 x 10-33 μm, globose to "cylindrico-inflated" and 1-3 celled (from Noordeloos, 1979), while the caulocystidia of *P. caribaea* are 54-102 x 14-54 µm and mostly ventricose, broadly ventricose or ventricose-rostrate. Finally, the cheilocystidia of *P. caribaea* do not become globose, subglobose, obpyriform, nor catenulate as seen in *P. dysthales* (Mazzer, 1976; Noordeloos, 1979 & 1992).

Noordeloos (1979) described *E. dysthaloides* from Europe and considered it similar to *P. dysthales* but differing mainly by smaller basidiospores which are 10.5-13.5(-15) x 6.8-8.2(-8.7) µm with a Q range of 1.4-1.6-1.8 for *E. dysthaloides*. Therefore, *E. dysthaloides* produces smaller basidiospores than *P. caribaea*. In addition, the caulocystidia of *E. dysthaloides* are conical-attenuate, clavate or rarely slightly swollen (Noordeloos, 1979). Thus the caulocystidia of *E. dysthaloides* differ markedly from the ventricose or ventricose-rostrate caulocystidia typical of *P. caribaea*.

As with most species of *Pouzarella, P. caribaea* appears to be rather rare and is currently known only from the type locality.

ACKNOWLEDGMENTS

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FIRST RECORD OF NEOLENTINUS SCHAEFFERI IN THE AMERICAS

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Abstract: *Neolentinus schaefferi*, a brown-rot agaric, is described for the first time for the Americas. The fungus and the culture obtained, are fully described and illustrated.

Key words: *Neolentinus schaefferi*, brown-rot, Americas.

INTRODUCTION

During a survey of the species of *Pleurotus* from southern South America, a collection was found which, upon a thorough study, was identified at first as *Lentinus cyathiformis* (Schaeff.) Bres. but later placed in *Neolentinus schaefferi* (Weinmann.) Redhead & Ginns, so far not recorded for the American Continent. This material conformed almost exactly to Pegler's description of the species given as *Lentinus cyathiformis* (Schaeff.) Bres. (Pegler, 1983), considered an incorrect name according to Redhead & Ginns' interpretation (Redhead & Ginns, 1985).

Species of the genus *Neolentinus* according to Redhead & Ginns (1985), cause brown rot permitting separation from *Lentinus*, with similar microscopic characteristics, which cause white rot.

Notwithstanding the fact that the specimen had been dried for three months, an attempt was made to obtain cultures, which proved successful. According to Pegler (1983), *N. schaefferi* has a northern to southern European distribution.

The species, as well as the culture obtained, is described and illustrated.

MATERIALS AND METHODS

Specimens were macro- and microscopically described. Colour names are in accordance with Munsell (1954) and Rayner (1970). Citation of author names of taxa is according to Kirk & Ansell (1992). Herbarium abbreviations follow Holmgren *et al.* (1990). Specimens and cultures are deposited in the BAFC Mycological Herbarium and culture collection, respectively. For examination, sections were mounted in 5% KOH and 1 % aqueous phloxine.

Cultures were inoculated in 90 mm Petri dishes using Nobles' (1948) medium and incubated in the dark at 25°C. During six weeks, aspect, colour, growth rate, odour and microscopic structures of both the aerial and submerged mycelium were observed weekly according to Nobles' (1965) protocol.

Production of oxidases and phenoloxidases was evaluated by growing the strain on tannic and gallic media (Nobles, 1965). Tyrosine, p-cresol and guaiacol spot tests were applied according to Boidin (1954). All the information thus obtained was codified in a "species code" according to Nobles (1965).

RESULTS

Neolentinus schaefferi (Weinmann.) Redhead & Ginns
Trans. Mycol. Soc. Japan 26: 357, 1985.

Pileus 7-8 cm (Figs. 1A, 3), at first hemispherical expanding to slightly depressed or cyathiform, brown (Munsell, 7.5YR 5/2-5/4); surface smooth when young, with minute punctiform furfuraceous-granular, tawny brown squamules, more densely distributed at the centre of the pileus; margin slightly incurved; flesh white 4.5-20 mm thick, thinner toward the margin. Lamellae 3 mm wide, deeply decurrent, white, those approaching the stem entire but denticulate toward the pileus margin. Stem eccentric, 2-3.2 cm long and 1.3-1.75 cm diam., dark brown (Munsell, 7.5YR, 5/4), covered with dense, small, furfuraceous squamules. Spore print white.

Spores 10.4-(12.6)-14 x 4.2-(4.7)-5.2 µm (Q= 2.67), cylindric-oblong to oblong, hyaline, thin-walled, IKI- (Fig. 1B). Basidia 36-37 x 5.2-5.7 µm, club-shaped, 4-spored (Fig. 1C). Cheilocystidia absent. Numerous basidioles or pleurocystidia present. Lamellae-edge with crowded, loose fascicles of cystidiform hairs, 2.6-5 µm diam. (Fig. 1D). Hymenophoral trama with descending construction, regular, parallel to subparallel at the base of the lamellae and more irregular toward the margin, with generative hyphae 2.6-3.2 µm diam. and skeletals 2.6-3.7 µm (Figs. 1E, F), more common toward the edge of the lamellae, unbranched, not tapered at the apex. Context of the pileus dimitic; generative hyphae 2.6-4.2 µm diam., thin-walled; skeletal hyphae 3.1-5 µm diam. slightly to very thick-walled (Fig. 2A). Generative hyphae of stem 2.6-4.2 µm diam., skeletal hyphae 2.6-4.7 µm diam. (Fig. 2B). Pileipellis a cutis 30-35 µm thick with radially parallel generative hyphae and thick to very thick-walled cylindric-clavate and semierect terminal elements, often forming short fascicles (Fig. 2C).

Material studied: ARGENTINA, Buenos Aires, La Plata, Parque Pereyra, leg. H. Spinedi, IV-2000, growing on stump of *Fraxinus* sp, BAFC 50727.

Cultures

Macroscopic Characters: Mycelial mat covering 90 mm Petri plates in 4-5 weeks, growing uniformly, whitish, loose and felty. After week four, colonies tended to form pegs from the middle to the margin of colony. Margin regular, compact at first and less well defined from the 2-3 week (Fig. 4). Reverse unstained. Odour resembling a urea derivative. No basidiocarps were produced during this period.

Microscopic characters: Hyphae hyaline, clamped, 2-5 µm diam. Terminal and intercalary hyaline chlamydospores, 11.5-19.5 x 8-8.5 µm, increasing in number with age of culture. Microdoplets absent.

Oxidase reactions: Tannic acid negative (-); gallic acid with growth and negative reaction (-); p-cresol negative (-), tyrosine negative (-).

Nobles' (1965) species code: 1.3.7.34.36.38.45.53.54.

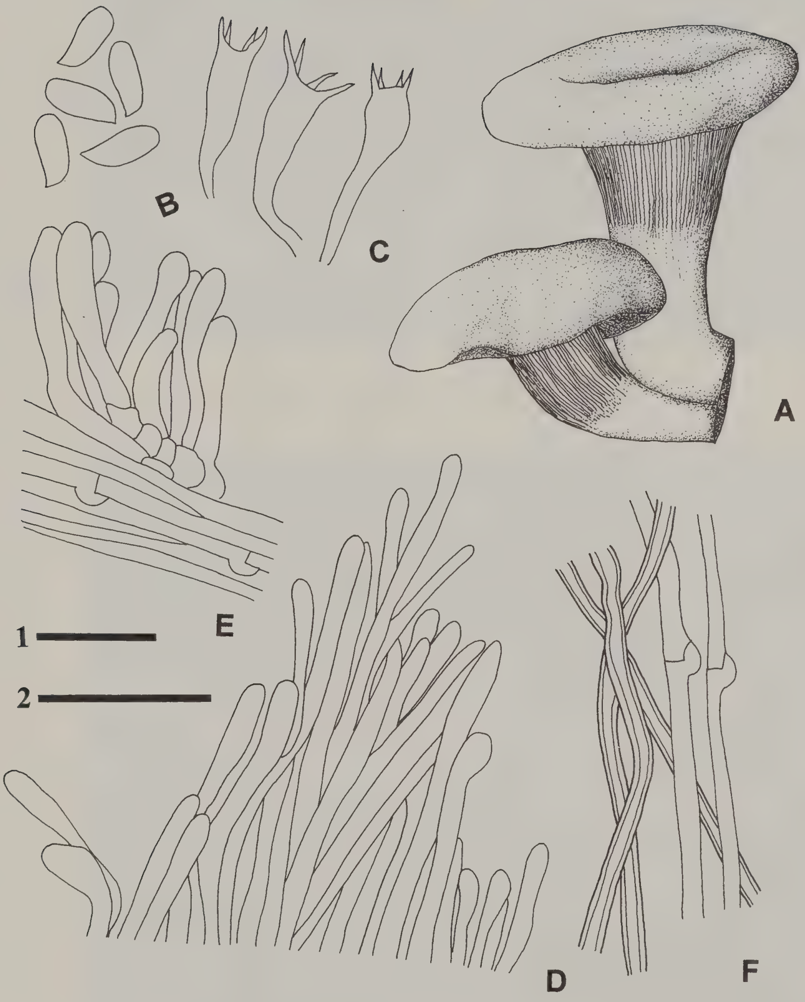

Fig. 1 *Neolentinus schaefferi*. Macro- and micromorphology. A) Basidiocarp; B) Spores; C) Basidia; D) Cystidiform hairs of the lamella edge; E) Hyphae of the trama with basidioles; F) Hyphae of the hymenophoral trama. Scale bar 1= 3 cm for A; scale bar 2= 20 µm for B to F.

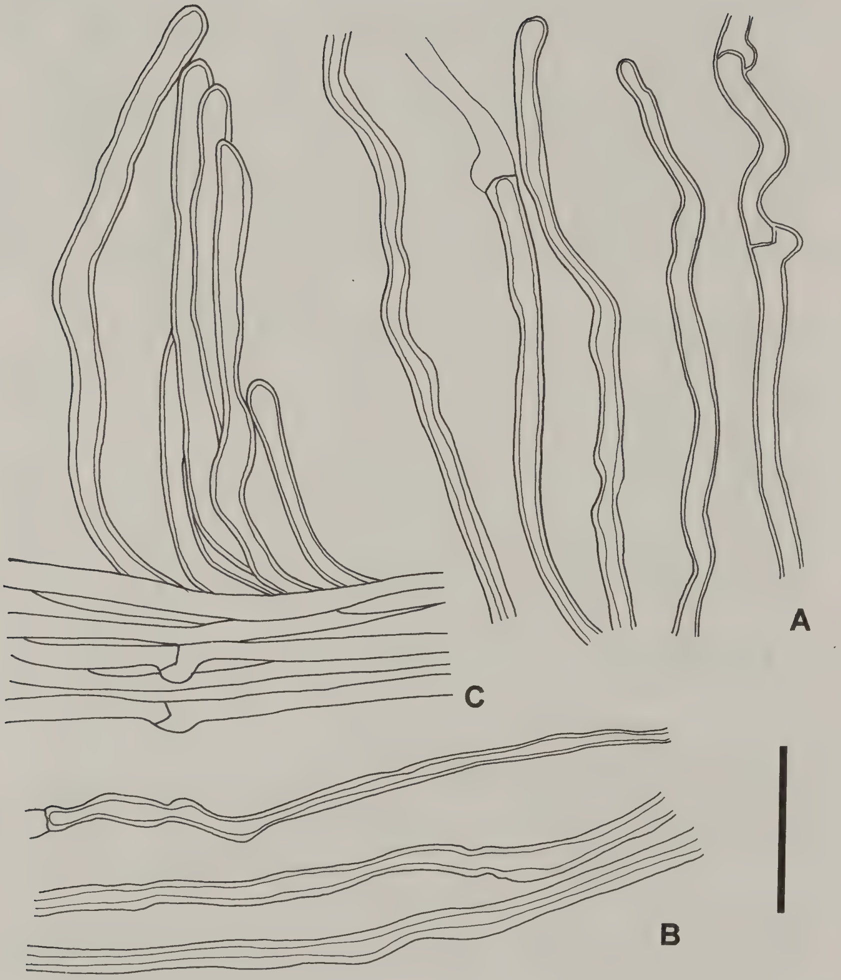

Fig. 2 *Neolentinus shaefferi*. Micromorphology. A) Hyphae of the pileus; B) Hyphae of the stem; C) Portion of the pileipellis. Scale bar= 20 µm.

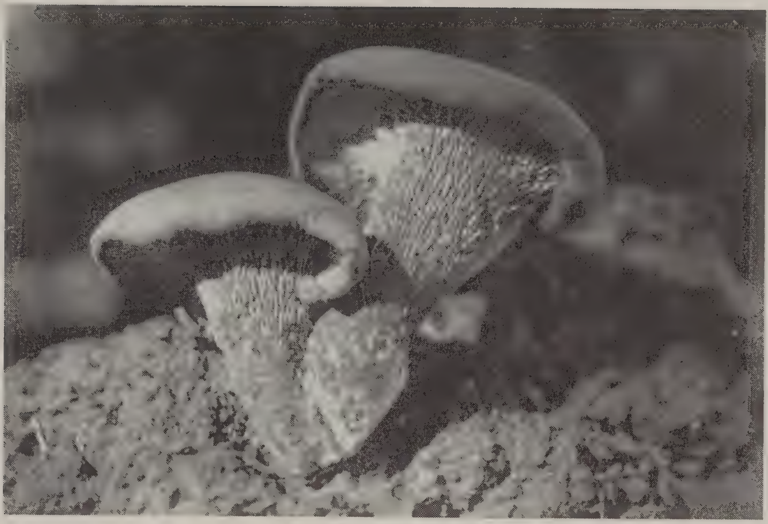

Fig. 3 Basidiocarp of *Neolentinus schaefferi*.

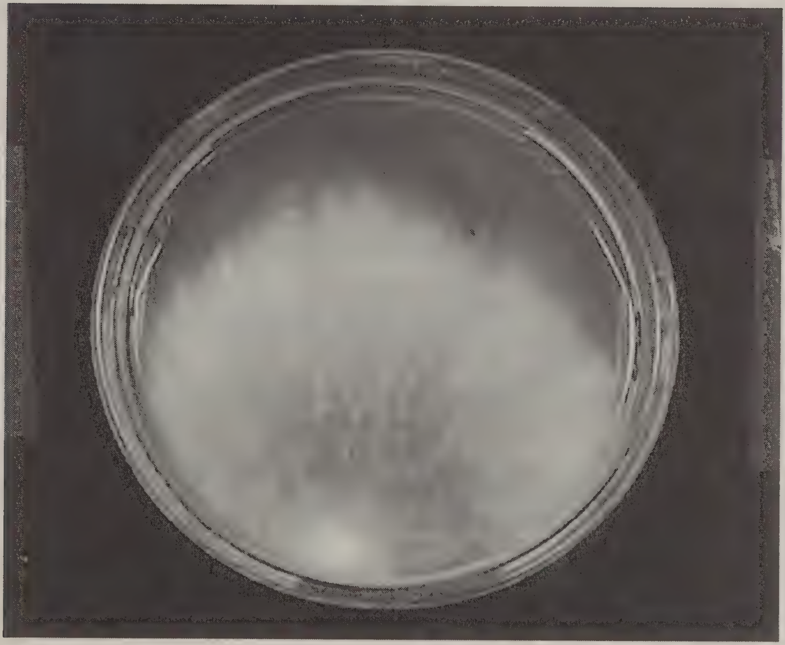

Fig. 4 Three weeks old culture of *Neolentinus schaefferi* on Nobles' medium

DISCUSSION

This report appears to be the first find of this species on the American Continent (cfr. Pegler, 1983) previously recorded mostly from central Europe and the Mediterranean (Kühner, 1928; Pilát, 1946; Romagnesi, 1967).

The cyathiform form of the pileus, the minute punctiform furfuraceous-granular squamules and the hymenophoral trama with descending construction with an entire to denticulate gill margin are the principal characteristics of this species.

The generic delimitation of *Pleurotus*, *Panus* and *Lentinus* has been and still is controversial. Phylogenetic studies (Hibbett & Vilgalys, 1993; Hibbett & Donoghue, 1995) have indicated that there are at least four separate clades for the pleurotoid-lentinoid fungal form, corresponding to *Pleurotus*, *Lentinus*, *Panus* and *Neolentinus*. The species of *Neolentinus* have no significant microscopic differences from *Lentinus*, but cause brown rot. The culture study according to Nobles' methodology, together with enzyme spot tests, allowed the conclusion that mycelia produce a brown rot, the characteristic which permits separation *Neolentinus* from *Lentinus* and *Pleurotus*, which cause white rots.

We tried to obtain basidiomes by culturing this strain on *Salix* sp sawdust following the traditional culture methods of *Pleurotus* species (Zadrazil 1974; Stamets 1993). Under these conditions the mycelium was very poor and fruitbodies were not induced. We also mixed sawdust with paper and obtained strong mycelia but fruitbodies were again not obtained.

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NEW RECORDS OF THE CORTICIACEAE FROM MAINLAND CHINA

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ABSTRACT

Twenty species of the Corticiaceae are newly recorded from mainland China, *viz. Aleurodiscus disciformis*, *A. monilifer*, *Boidinia granulata*, *Cylindrobasidium torrendii*, *Cystidiodontia laminifera*, *Dendrophora albobadia*, *Gloeocystidiellum aspellum*, *Hyphoderma griseoflavescens*, *H. subdefinitum*, *H. subpraetermissum*, *Hyphodontia barba-jovis*, *H. crassa*, *H. crustosa*, *H. niemelaei*, *Laxitextum bicolor*, *Lopharia mirabilis*, *Peniophora incarnata*, *Porostereum spadiceum*, *Tubulicium raphidosporum*, and *T. vermiferum*.

Key words: Aphyllophorales, Basidiomycota, taxonomy.

INTRODUCTION

The concept of the Corticiaceae Herter adopted in this paper was described by Wu (2000). The first contributions to the knowledge of the Corticiaceae in mainland China were first contributed by S.C. Teng and S.H. Ou during 1934-1939, and these species were compiled by Teng (1939). The traditional generic names such as *Aleurodiscus*, *Corticium* and *Peniophora* were adopted in his book. A revised edition of this book was published recently (Teng, 1996) after Teng died. Yin (1980) reported 42 species of resupinate Aphyllophorales new to China, with many of them belonging to the Corticiaceae. His study was based on part of the specimens deposited at HMAS.

Hjortstam and Ryvarden (1988) reported 98 species of the Corticiaceae s.l. from Changbaishan Forest Reserve in northeastern China. The majority of the species were new to China. Maekawa and Zang (1995) reported 77 species of the Corticiaceae from Yunnan Province of China, about half number of them were new to mainland China. These are the principal contributions to the Corticiaceae of mainland China.

The author believes the number of known species (ca. 1,000) of the Corticiaceae of the world is less than unknown species. The author estimates that about 1,000 species of the Corticiaceae are present in mainland China, representing over one third of the number present in the world. About 200 species of the Corticiaceae are known in mainland China, representing about 20 % of the species present there.

This paper presents twenty species of the Corticiaceae newly recorded from mainland China. Some specimens were borrowed from the Microbiological Institute of Academia Sinica in Beijin (HMAS), and the rest of the specimens were collected by the auhtor and colleagues in the recent years. Some of the species have been recorded from Taiwan. About 200 species of the Corticiaceae are known in Taiwan (Wu, 2000). The author estimates that about 400 species or more of the Corticiaceae are present in Taiwan. For the purpose of this paper the term "mainland China" is used to indicate the Chinese territory exclusive of the islands, of which Taiwan and Hainan are the largest.

LIST OF THE SPECIES AND SPECIMENS

1. ***Aleurodiscus disciformis*** (DC.:Fr.) Pat., Bull. Soc. Mycol. Fr. 10: 80. 1894.
Specimens examined. China. Changbaishan, Hantsungkou, alt. 740 m, on trunk bark of rotten *Acer* sp., 11-IX-1983, coll. Jen-Tan Kao & Lin Kao, *CR 22* (HMAS); 15-IX-1983, coll. Jen-Tan Kao & Lin Kao, *CR 337, 347, 364* (HMAS).
Distribution. Pantemperate.

2. ***Aleurodiscus monilifer*** Malencon, Bull. Soc. Mycol. France 70: 130. 1954.
Specimen examined. China. Xizang (Tibet): Zongang, Chayi Area, Chialang, on trunk of oak, 5-X-1982, coll. *Jian-Yun Su 5764* (HMAS 61296).
Distribution. Higher altitudes in Morocco (Azrou) (Núñez and Ryvarden, 1997), China (Tibet).
Remarks. General features of this specimen resemble *Aleurodiscus monilifer*, but *A. monilifer* has slightly narrower basidiospores (22-26 x 14-17 μm, according to Núñez and Ryvarden (1997)). Spores on Tibet specimen measured 20-26 x 15-20 μm in this study. This difference can be regarded as variation between populations of the same species.

3. ***Boidinia granulata*** Sheng H. Wu, Mycotaxon 58: 17. 1996

Specimens examined. China. Yunnan: Yungshan Hsien, Hsisha Hsiang, Sanchiangkou Forest Farm, Heisenlin, alt. 1,900 m, on branch of angiosperm, 20-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-104* (TNM). Sanchiangkou Forest Farm, alt. 1,900 m, 21-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-213* (TNM).

Distribution. Réunion, Taiwan (type locality), China (Yunnan).

4. ***Cylindrobasidium torrendii*** (Bres.) Hjortstam, Mycotaxon 17: 571. 1983.

Specimens examined. China. Yunnan: Xishuangbanna, Mengyang, Sanchaho, Wild Elephant Valley, alt. 800m, on branch of angiosperm, 14-VIII-1997, coll. S.H. Wu & S.Z. Chen, *Wu 9708-109* (TNM). Sichuan: Chingchenghoushan, Wulungkou, alt. 900 m, on branch of angiosperm, 13-X-2000, coll. S.H. Wu & S.C. Wu, *Wu 0010-117* (TNM).

Distribution. South Europe, Africa, North America, Taiwan, China (Sichuan and Yunnan).

5. ***Cystidiodontia laminifera*** (Berk. & M.A. Curtis) Hjortstam, Mycotaxon 39: 416. 1990.

Specimen examined. China. Yunnan: Xishuangbanna, Santashan, Sun Valley Primitive Forest Park, alt. 750m, on rotten wood of angiosperm, 13-VIII-1997, coll. S.H. Wu & S.Z. Chen, *Wu 9708-67* (TNM).

Distribution. South and Central America, Taiwan, China (Yunnan).

6. ***Dendrophora albobadia*** (Schwein.:Fr.) Chamuris, Mycotaxon 28: 544. 1987.

Specimen examined. China. Yunnan: Yungshan Hsien, Hsisha Hsiang, Sanchiangkou Forest Farm, Heisenlin, alt. 1,900 m, on branch of angiosperm, 20-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-160* (TNM).

Distribution. Central and South America, USA, China (Yunnan).

7. ***Gloeocystidiellum aspellum*** Hjortstam, Mycotaxon 28: 27. 1987.

Specimen examined. China. Yunnan: Xishuangbanna, Menghai, Nabanho, alt. 600 m, on stump of angiosperm, 16-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-291* (TNM).

Distribution. Kenya (type locality), Taiwan, China (Yunnan).

8. ***Hyphoderma griseoflavescens*** (Litsch.) Jülich, Persoonia 8: 80. 1974.

Specimens examined. China. Yunnan: Yungshan Hsien, Hsisha Hsiang, Sanchiangkou Forest Farm, Heisenlin, alt. 1,900 m, on branch of angiosperm, 20-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-139*, *9809-169* (TNM).

Distribution. Europe, China (Yunnan).

9. ***Hyphoderma subdefinitum*** J. Erikss. & Å. Strid, Cort. N. Europe 3: 539. 1975.
Specimens examined. China. Yunnan: Yiliang, Shiaotsaopa, Houho, alt. 2,000 m, on branch of angiosperm, 18-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-87*, *9809-89* (TNM).
Distribution. Europe, China (Yunnan).

10. ***Hyphoderma subpraetermissum*** Sheng H. Wu, Bot. Bull. Acad. Sin. 38: 68. 1997.
Specimens examined. China. Yunnan: Yiliang, Shiaotsaopa, Niuchiaoyai, alt. 1,850 m, on branch of angiosperm, 17-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-41* (TNM). Shiaotsaopa, Houho, alt. 2000 m, on branch of angiosperm, 18-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-69* (TNM).
Distribution. Taiwan (type locality), China (Yunnan).

11. ***Hyphodontia barba-jovis*** (Bull.:Fr.) J. Erikss., Symb. Bot. Ups. 16(1): 104. 1958.
Specimens examined. China. Yunnan: Yungshan Hsien, Hsisha Hsiang, Sanchiangkou Forest Farm, Heisenlin, alt. 1,900 m, on branch of angiosperm, 20-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-106* (TNM).
Distribution. Pantemperate.

12. ***Hyphodontia crassa*** Z.C. Chen & S.H. Lin, Taiwania 35: 81. 1990.
Specimens examined. China. Yunnan: Xishuangbanna, Mengyang, Sanchaho, Wild Elephant Valley, alt. 800m, 14-VIII-1997, Coll. S.H. Wu & S.Z. Chen, *Wu 9708-110* (TNM). Menglun, Tropical Botanical Garden, alt. 500 m, on branch of angiosperm, 16-VIII-1997, coll. S.H. Wu & S.Z. Chen, *Wu 9708-228* (TNM). Menglun, Green Stone Forest Park, alt. 650m, 18-VIII-1997, coll. S.H. Wu & S.Z. Chen, *Wu 9708-284* (TNM).
Distribution. Taiwan (type locality), China (Yunnan).

13. ***Hyphodontia crustosa*** (Pers.:Fr.) J. Erikss., Symb. Bot. Ups. 16(1): 104. 1958.
Specimens examined. China. Yunnan: Yiliang, Shiaotsaopa, Niuchiaoyai, alt. 1,850 m, on branch of angiosperm, 17-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-24*, *9809-42* (TNM). Sichuan: Wolungshan, Tengsheng, alt. 2,700 m, on branch of angiosperm, 11-X-2000, coll. S.H. Wu & S.C. Wu, *Wu 0010-49* (TNM).
Distribution. Pantemperate — warm-temperate.

14. ***Hyphodontia niemelaei*** Sheng H. Wu, Acta Bot. Fennica 142: 98. 1990.
Specimens examined. China. Yunnan: Tientzupa, alt. 1,900 m, on bark of angiosperm, coll. S.H. Wu & J.Y. Tseng, *Wu 9507-13* (TNM). Xishuangbanna, Menglun, Tropical Botanical Garden, alt. 500 m, on branch of *Bougainvillea glabra*, 10-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-138*, *9508-140* (TNM); Menglun Nature Reserve, alt. 750 m, on branch of angiosperm, 17-VIII-1997, coll. S.H. Wu & S.Z. Chen, *Wu*

9708-239 (TNM). Yungshan Hsien, Hsisha Hsiang, Sanchiangkou Forest Farm, Heisenlin, alt. 1,900 m, on branch of angiosperm, 20-IX-1998, coll. S.H. Wu & J.Y. Tseng, *Wu 9809-124*, (TNM).

Distribution. Taiwan (type locality), China (Yunnan).

15. ***Laxitextum bicolor*** (Pers.:Fr.) Lentz, U.S.D.A. Monogr. 24: 19. 1956.

Specimens examined. China. Yunnan: Kunming, Chiumuyuien, alt. 1,800 m, on rotten wood, 16-VIII-1985, coll. *Y.L. Tan 572*. Fujien: Wuyishan, kaochiao, alt. 710 m, on rotten wood of angiosperm, 30-X-1985, coll. *Q.X. Wu 671* (HMAS).

Distribution. Pan temperate-subtropical.

16. ***Lopharia mirabilis*** (Berk. & Br.) Pat., Bull. Soc. Mycol. Fr. 11: 14. 1895.

Specimens examined. China. Yunnan: Xishuangbanna, Menglun, on rotten wood, 25-XII-1975, *Han et al. 147* (HMAS). Menglun, Tropical Botanical Garden, alt. 500 m, on branch of angiosperm, 10-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-144* (TNM); on rotten trunk of angiosperm, 16-VIII-1997, coll. S.H. Wu & S.Z. Chen, *Wu 9708-214* (TNM). Xishuangbanna, Menghai, Nannoshan, alt. 1,400 m, on branch of angiosperm, 15-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-271* (TNM). Kungming, Heilungtan, Botanical Garden, alt. 1,850 m, on branch of angiosperm, coll. S.H. Wu & J.Y. Tseng, *Wu 9507-2* (TNM). Sichuan: Chingchenghoushan, Feichuankou, alt. 900 m, on branch of angiosperm, 13-X-2000, coll. S.H. Wu & S.C. Wu, *Wu 0010-110* (TNM).

Distribution. Paleotropical.

17. ***Peniophora incarnata*** (Pers.:Fr.) P. Karst., Hedwigia 28: 27. 1889.

Specimen examined. China. Sichuan: Wolungshan, Tengsheng, alt. 2,900 m, on branch of angiosperm, 19-X-2000, coll. S.H. Wu & S.C. Wu, *Wu 0010-3* (TNM).

Distribution. Pantemperate.

18. ***Porostereum spadiceum*** (Per.:Fr.) Hjortstam & Ryvarden, Synop. Fung. 4: 51. 1990.

Specimens examined. China. Yunnan: Simao, Taokuansai, alt. 1,400 m, on rotten wood, coll. *L.W. Hsu & Q.C. Wang 1005* (HMAS). Xishuangbanna, Mengyang, Sanchaho, Wild Elephant Valley, alt. 800m, on branch of angiosperm, 14-VIII-1997, coll. S.H. Wu & S.Z. Chen, *Wu 9708-104* (TNM).

Distribution. Europe, Africa, Asia, Australia.

19. ***Tubulicium raphidosporum*** (Boidin & Gilles) Oberw., Kisimova & L.D. Gómez, Rev. Biol. Trop. 45: 1313. 1997.

Specimens examined. China. Yunnan: Xishuangbanna, Menglun, Tropical Botanical Garden, alt. 500 m, on branch of angiosperm, 11-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-204* (TNM). Menglun Nature Reserve, Rd. no. 53, alt. 600 m, on branch of angiosperm, 12-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-226* (TNM). Menghai, Nannoshan, alt. 1,400 m, on branch of angiosperm, 15-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-270* (TNM). Menghai, Nabanho, alt. 600 m, on culm of bamboo, 16-VIII-1995, coll. S.H. Wu & J.Y. Tseng, *Wu 9508-287*, *9508-303* (TNM).

Distribution. Pan tropical-subtropical.

Remarks. *Tubulicium raphidosporum* resembles *T. vermiferum*, but differs in having narrower basidiospores. The former is a tropical-subtropical species, while the latter is distributed in temperate or warm-temperate regions.

20. ***Tubulicium vermiferum*** (Bourdot) Oberw. ex Jülich, Persoonia 10: 335. 1979.

Specimen examined. China. Yunnan: Kungming, Heilungtan, Botanical Garden, alt. 1,850 m, on rotten trunk of *Eucalyptus maideni*, 24-VII-2001, coll. S.H. Wu & S.Z. Chen, *Wu 0107-2* (TNM).

Distribution. Pantemperate — warm-temperate.

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CLADISTIC ANALYSIS OF THE POLYPORACEAE USING MORPHOLOGICAL CHARACTERS

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ABSTRACT

Cladistic analysis of the Polyporaceae was performed using morphological characters. Species of the Polyporaceae and poroid taxa of related families were compared using 34 characters. Analyses were performed for characters that were unweighted, weighted twice or five times. Results showed that the most parsimony tree inferred from unweighted analysis was topologically different from those of weighted analyses. The more weights were given on taxonomically important characters, the more significant influences were expected on tree topologies. From the analysis using characters partly weighted five times, 17 monophyletic groups of taxonomic implication were recognized for the Polyporaceae.

Key Words: cladistics, tree topology, weighting

INTRODUCTION

The family Polyporaceae consists of major wood decayers and tree pathogens in forest systems. Due to extensive wood rots caused by them, the Polyporaceae has attracted many researchers in both basic and applied researches (Gilbertson, 1980, 1981; Wainwright, 1992). However, in spite of extensive studies on this group, the taxonomic status of the Polyporaceae is still unstable and has many unsettled problems, especially at the family level

(Donk, 1964; Gilbertson and Ryvarden, 1986, 1987; Hibbett and Donoghue, 1995; Jülich, 1981; Jülich and Stalpers, 1980; Ryvarden, 1991; Ryvarden and Gilbertson, 1993, 1994). Most of taxonomists working with the Polyporaceae acknowledge that the Polyporaceae is not a natural group of phylogenetically related clades.

The polyphyly of the Polyporaceae has been suggested by many authors (Alexopoulos *et al.*, 1996; Donk, 1964, 1971a, 1971b; Hibbett and Donoghue, 1995; Jülich, 1981; Jülich and Stalpers, 1980; Ryvarden, 1991). Historically, the Polyporaceae has not been defined by homologous characters of included genera and species but merely as a container of the remaining genera not assigned to more natural families (Donk, 1964, 1971b; Ryvarden, 1991). As a result, diverse types of macro- and microscopic characters occur in this group. All types of fruitbodies (resupinate, effused to reflexed, pileate, stipitate) and hymenophores (poroid, lamellate, hydnoid, irpicoid) occur in the Polyporaceae. The situation is same in microscopic characters. All kinds of hyphal systems (monomitic, dimitic with skeletal hyphae or binding hyphae, trimitic) commonly occur. Both brown and white rot types are present, and in sexuality, all types of sexuality (homothallic, heterothallic bipolar, heterothallic tetrapolar) exist (Gilbertson and Ryvarden, 1986, 1987; Nobles, 1971; Ryvarden, 1991; Ryvarden and Gilbertson, 1993, 1994).

Throughout the history of polypore taxonomy, progresses have been continued to split the Polyporaceae into more natural families. The main trends were to exclude some small homogeneous groups from the Polyporaceae and make them their own families. Bondarzewiaceae, Hymenochaetaceae, Ganodermataceae and Albatrellaceae are good examples of such families segregated from the Polyporaceae and elevated into their own families (Donk, 1971b). Another means were to transfer some genera from the Polyporaceae into other families that were regarded as taxonomically or phylogenetically related with. There are *Serpula*, *Merulius*, *Porotheleum*, *Fistulina*, *Boletopsis* and *Phaeolus* for such examples (Donk, 1971b). In spite of continuous improvements to remove residual groups of the Polyporaceae, the family still remains as a heterogeneous and artificial assemblage.

Several authors have tried to classify the residual taxa of the family into smaller and putatively more natural families with common evolutionary backgrounds. Jülich (1981) was one of the revolutionary mycologists who largely discussed higher level relationships among polypore taxa and suggested many new orders and families mainly based on hyphal systems and spore morphology. On the other hand, Ryvarden (1991) has suggested another relationships among polypore taxa. Mitic system, presence or absence of clamps, spore morphology and rot type were important characters used in his grouping polypores. He divided the Polyporaceae into 11 groups of high affinity and residual taxa of uncertain affinity and also performed numerical phenetic analyses for the Polyporaceae (Ryvarden, 1991).

Recently, molecular data have been applied for the phylogenetic studies of the Polyporaceae. Hibbett and Donoghue (1995) tried to classify the polyporoid taxa into more natural taxa using mitochondrial small subunit ribosomal DNA (mt-ssu rDNA) sequences and, with some limitations, figured out seven groups among which six groups belonged to the species of the Polyporaceae. Ko *et al*. (1997) have performed a phylogenetic study on *Trichaptum* of the Polyporaceae using nuclear small subunit ribosomal DNA (nuc-ssu rDNA) sequences and reinforced the monophyly of *Trichaptum* and the relatedness of *Trichaptum* with the Hymenochaetaceae sharing the same type of imperforate parenthosomes. Quite lately, Hibbett and Thorn (2001) suggested a preliminary outline of homobasidiomycete phylogenetics by dividing the homobasidiomycetes into eight mutually exclusive clades and the taxa of the Polyporaceae were assigned to at least four major clades.

Difficulties encountered in the natural classification of the Polyporaceae originated from the nature of characters, basically because almost all characters, both macroscopic and microscopic, show a lot of homoplasies which mask possible evidences of evolutionary histories. Macroscopic characters of basidiocarp or hymenophore morphology tend to show more homoplasies than microscopic features such as spore morphology, Melzer's reactions of basidiospores and hyphae, miticity of hyphal systems and the existence of clamps in generative hyphae (Corner, 1989; Hibbett and Donoghue, 1995; Ryvarden, 1991), even though microscopic characters also show a good amount of homoplasies (Ryvarden, 1991).

In the course of development of systematic theories, two major schools, phenetics and cladistics, have grown for evolutionary systematics during decades. Systematists acknowledge the subjective choice of taxonomically important characters (Mayr and Ashlock 1992; Stuessy, 1990). However, pheneticists seek objective classification by giving equal weights on characters, using total aspects of organisms by investigating as many characters as possible and adopting standardized experimental analysis procedures (Priest and Austin, 1993; Farris, 1969; Felsenstein 1983; Sneath and Sokal, 1973). On the other hand, cladists use only synapomorphic characters of genealogical relationships among the taxa that we study in establishing classification (Forey *et al*., 1992; Scott-Ram, 1990; Swofford, 1999; Wiley *et al*., 1991).

Taxonomic schools treat given data sets in different ways and sometimes produce totally different results from one another. While the numerical phenetics rather indirectly seeks phylogenetic relationships based on phenetic similarity, cladistic approaches directly seek phylogenetic history using various tools to trace and reconstruct character changes (Hibbett and Vilgalys, 1993; Langer, 1994; Lutzoni and Vilgalys, 1995; McLaughlin *et al*., 1995; Morton, 1995; Parmasto, 1995; Vilgalys, 1986; Zeller, 1995). Concepts and methods of the cladistics analysis have been rapidly developed since its first appearance in 1966, and nowadays cladistics-based powerful programs such as PAUP* (Swofford, 1999) and MacClade (Maddison and Maddison, 1993) are in widespread use among biological taxonomists. This study was attempted to split the great family Polyporaceae into putatively more natural groups through cladistic analyses performed on morphological data.

MATERIALS AND METHODS

Delimitation of groups

Based on taxonomic concepts of the Polyporaceae suggested by Ryvarden (1991), total eighty nine species were included in the study and listed in Table 1. Some poroid taxa like *Albatrellus ovinus, Anomoporia albolutescens, Coltricia perennis, Ganoderma lucidum, Phellinus gilvus, Schizopora paradoxa* and *Wrightoporia avellanea* are accepted in other families of the order depending on authors but were included in the current analysis simply because they were once treated in the Polyporaceae of broad sense.

Table 1. List of taxa included in the cladistic analysis of the Polyporaceae based on morphological characters.

Abortiporus biennis	*Albatrellus ovinus*	*Amylocystis lapponicus*
Anomoporia bombycina	*Antrodia carbonica*	*Antrodiella semisupina*
Auriporia aurea	*Bjerkandera adusta*	*Ceriporia viridans*
Ceriporiopsis gilvescens	*Cerrena unicolor*	*Climacocystis borealis*
Coltricia perennis	*Cryptoporus volvatus*	*Daedalea quercina*
Daedaleopsis confragosa	*Datronia mollis*	*Diacanthodes novo-guineensis*
Dichomitus squalens	*Diplomitoporus flavescens*	*Donkiporia expansa*
Earliella scabrosa	*Echinochaete brachyporus*	*Echinoporia hydnoporia*
Flaviporus brownii	*Flavodon flavus*	*Fomes fomentarius*
Fomitella supina	*Fomitopsis pinicola*	*Fuscocerrena portoricensis*
Ganoderma lucidum	*Globifomes graveolens*	*Gloeophyllum sepiarium*
Gloeoporus thelephoroides	*Grifola frondosa*	*Hapalopilus nidulans*
Haploporus odorus	*Heterobasidion annosum*	*Hexagonia hydnoides*
Hydnopolyporus fimbriatus	*Inonotus hispidus*	*Irpex lacteus*
Ischnoderma resinosum	*Jahnoporus hirtus*	*Junghuhnia nitida*
Laetiporus sulphureus	*Lenzites betulina*	*Leptoporus mollis*
Lignosus sacer	*Loweporus fusco-purpureus*	*Macrohyporia dictyopora*
Megasporoporia cavernulosa	*Melanoporella carbonaceus*	*Melanoporia nigra*
Meripilus giganteus	*Microporellus dealbatus*	*Microporus xanthopus*
Nigrofomes melanoporus	*Nigroporus vinosus*	*Oligoporus rennyii*
Oxyporus populinus	*Pachykytopora tuberculosa*	*Parmastomyces transmutans*
Perenniporia medulla-panis	*Phaeolus schweinitzii*	*Phellinus gilvus*
Phellinus igniarius	*Physisporinus vitreus*	*Piloporia sajanensis*
Piptoporus betulinus	*Podofomes trogii*	*Polyporoletus sublividus*
Polyporus squamosus	*Porodisculus pendulus*	*Pseudopiptoporus devians*
Pycnoporellus fulgens	*Pycnoporus cinnabarinus*	*Pyrofomes demidoffii*
Rigidoporiopsis amylospora	*Rigidoporus microporus*	*Schizopora paradoxa*
Skeletocutis amorpha	*Spongipellis spumeus*	*Tinctoporellus epimiltinus*
Trametes versicolor	*Trichaptum perrottetii*	*Tyromyces chioneus*
Wolfiporia cocos	*Wrightoporia avellanea*	

Morphological characters

Thirty four characters were used (Table 2) for the present research.

Table 2. List of transformation series of characters and character states used in the cladistic analysis of the Polyporaceae.

1. Life strategy: annual = 0, biennial = 1, perennial = 2
2. Basidiocarp morphology: resupinate = 0, effused to reflexed = 1, pileate = 2, stipitate =3
3. Type of stipes: central stipe = 0, eccentric stipe =1, lateral stipe = 2
4. Type of basidiocarps: semicircular = 0, elongated = 1, dimidiate = 2, flabelliform = 3, spatulate =4, circular = 5
5. Attachment of pilei: applanate = 0, ungulate = 1, convex = 2, imbricate = 3, triquetrous = 4
6. Color of the pileal surface: white = 0, yellow = 1, brown = 2, red = 3, black = 4
7. Margin: entire = 0, finely fimbriate = 1, rhizomorphic =2
8. Attachment of hymenophores: adnate = 0, separable = 1
9. Texture: soft = 0, tough = 1
10. Odor: absent = 0, present = 1
11. Color of the pore surface: white = 0, yellow = 1, brown = 2, red = 3, black = 4
12. Pore shape: angular = 0, circular = 1, irregular = 2, daedaloid = 3, labyrinthine = 4, dentate (lacerate-split) = 5, lamellate = 6
13. Pore size: 1 per mm = 0, 1-2 per mm = 1, 2-4 per mm = 2, 4-7 per mm = 3, 7-10 per mm = 4, over 10 per mm = 5
14. Color of subiculum: white = 0, yellow = 1, brown = 2, red = 3, black = 4
15. Color of tubes: white = 0, yellow = 1, brown = 2, red = 3, black = 4
16. Mitic system: monomitic = 0, dimitic with skeletals = 1, dimitic with binding hyphae = 2, trimitic = 3
17. Special type of generative hyphae: absent = 0, gloeoplerous hyphae = 1, sclerified generative hyphae = 2, hyphae covered with crystals = 3, colored generative or skeletal hyphae = 4, inflated hyphae = 5
18. Clamps: absent = 0, present = 1
19. Reaction of hyphae in Melzer's reagent: inamyloid = 0, amyloid = 1, dextrinoid = 2, hyphal color change in KOH = 3
20. Cystidia: none = 0, hymenial = 1, tramal = 2, cystidioles = 3, gloeocystidia = 4, hyphoid cystidia = 5, dendrohyphidia = 6, hyphal pegs = 7, setae = 8, leptocystidia = 9, fusiform cystidia = 10, setoid elements = 11
21. Cystidial encrustation: no encrustation = 0, apically encrustated = 1, wholly encrustated = 2
22. Amyloidity of cystidia: none = 0, amyloid = 1, dextrinoid = 2
23. Basal clamp at basidia: simple-septate = 0, clamped = 1
24. Size of basidia: below 10 μm = 0, 10-15 μm = 1, 15-20 μm = 2, 20-25 μm = 3, 25-30 μm = 4, 30-35 μm = 5, 35-40 μm = 6, 40-45 μm = 7, over 45 μm = 8
25. Spore morphology: globose = 0, subglobose = 1, ellipsoid = 2, allantoid = 3, oblong = 4, cylindrical = 5
26. Spore wall thickness: thin = 0, thick = 1
27. Spore color: hyaline = 0, colored = 1
28. Reaction of basidiospores in Melzer's reagent: inamyloid = 0, amyloid = 1, dextrinoid = 2
29. Spore surface ornamentation: smooth = 0, crested = 1, warted = 2, asperulate = 3, echinulate = 4, truncated = 5, verrucose = 6
30. Spore size: below 5 μm = 0, 5-7 μm = 1, 7-10 μm = 2, above 10 μm = 3
31. Type of rot: brown = 0, white = 1, no wood rot (terrestrial) = 2
32. Substratum: conifers (specific) = 0, conifers (broad) = 1, hardwoods (specific) = 2, hardwoods (broad) = 3, ground = 4
33. Sexuality: homothallic = 0, heterothallic bipolar = 1, heterothallic tetrapolar = 2
34. Asexual organs: absent = 0, chlamydospores = 1, conidia = 2, sclerotium = 3

Quantitative characters like pore size, size of basidia and size of spores were coded into discrete characters based on the frequency described in literature. There are predefined and user-defined types in character transformations for cladistic analysis. All characters were initially submitted to an unordered predefined type. And then a different transformation (Table 3) was applied to six characters (basidiocarp morphology, pore size, size of basidia, spore morphology, spore size, sexuality) for an ordered predefined type based on assumptions that those characters might have evolved in an ordered successive way. As an example, the basidiocarp morphology was assumed to have evolved from resupinate, effused-reflexed, pileate, and finally to stipitate forms.

Table 3. Character types and weights used in the cladistic analysis of the Polyporaceae.

Characters	Transformation types	Weights
1. Life strategy	unordered	1
2. Basidiocarp morphology	ordered	1
3. Type of stipes	unordered	1
4. Type of basidiocarps	unordered	1
5. Attachment of pilei	unordered	1
6. Color of the pileus surface	unordered	1
7. Margin	unordered	1
8. Attachment of hymenophores	unordered	1
9. Texture	unordered	1
10. Odor	unordered	1
11. Color of the pore surface	unordered	1
12. Pore shape	unordered	1
13. Pore size	ordered	1
14. Color of subiculum	unordered	1
15. Color of tubes	unordered	1
16. Mitic system	user-defined	1, 2, 5
17. Special type of generative hyphae	user-defined	1
18. Presence or absence of clamps	unordered	1, 2, 5
19. Reaction of hyphae in Melzer's reagent	user-defined	1
20. Cystidia	user-defined	1
21. Cystidial encrustation	user-defined	1
22. Amyloidity of cystidia	user-defined	1
23. Presence or absence of a basal clamp at basidia	unordered	1
24. Size of basidia	ordered	1
25. Spore morphology	ordered	1
26. Spore wall thickness	unordered	1
27. Spore color	unordered	1
28. Reaction of basidiospores in Melzer's reagent	user-defined	1, 2, 5
29. Spore surface ornamentation	user-defined	1, 2, 5
30. Spore size	ordered	1
31. Type of rot	unordered	1, 2, 5
32. Substratum	unordered	1
33. Sexuality	ordered	1
34. Asexual organs	user-defined	1

A user-defined transformation (Table 4) was applied to nine characters (mitic system, special types of generative hyphae, reaction of hyphae in Melzer's reagent, cystidia, cystidial encrustation, amyloidity of cystidia, reaction of basidiospores in Melzer's reagent, spore surface ornamentation, asexual organs). These user-defined types hypothesize specific evolutionary pathways of characters and have the effect of splitting multistate character states into corresponding binary character states. For instance, the mitic system (Table 4A) was defined with the premise that monomitic system would develop into trimitic system through dimitic system with skeletal hyphae or with binding hyphae or vice versa. Other characters (Table 4B) for the user-defined transformation were compiled from published descriptions (Gilbertson and Ryvarden, 1986, 1987; Ryvarden and Gilbertson, 1993, 1994) and step matrices were specified by MacClade 3.04 (Maddison and Maddison, 1993).

Table 4. Step matrices of nine user-defined characters.

A. Number of steps between states in the character 16 (mitic system).

From \ To	State 0	1	2	3
State 0	0	1	1	2
1	1	0	1	1
2	1	1	0	1
3	2	1	1	0

B. Number of steps between states in characters 17, 19, 20, 21, 22, 28, 29 and 34.

From \ To	State 0	1	2	3	4	5	6	7	8	9	10	11
State 0	0	1	1	1	1	1	1	1	1	1	1	1
1	1	0	2	2	2	2	2	2	2	2	2	2
2	1	2	0	2	2	2	2	2	2	2	2	2
3	1	2	2	0	2	2	2	2	2	2	2	2
4	1	2	2	2	0	2	2	2	2	2	2	2
5	1	2	2	2	2	0	2	2	2	2	2	2
6	1	2	2	2	2	2	0	2	2	2	2	2
7	1	2	2	2	2	2	2	0	2	2	2	2
8	1	2	2	2	2	2	2	2	0	2	2	2
9	1	2	2	2	2	2	2	2	2	0	2	2
10	1	2	2	2	2	2	2	2	2	2	0	2
11	1	2	2	2	2	2	2	2	2	2	2	0

All characters were given equal weights in an initial analysis. In the subsequent analyses, two and five times weights were given to five characters (mitic system, presence or absence of clamps, reaction of basidiospores in Melzer's reagent, spore surface ornamentation, type of rot) which have been admitted as important in current taxonomies by morphological taxonomists (Donk 1964; Furtado, 1966; Ryvarden, 1991; Teixeira, 1962) and molecular workers on the Polyporaceae and related taxa (Hibbett and Donoghue 1995; Ko *et al.*, 1997; Lee and Jung, 1997). Determination of the absolute value of weighting was based on the molecular phylogenetic results of Hibbett and Donoghue (1995). The ultrastructure of a septal pore cap (parenthosome) in the dolipore apparatus (Traquair and McKeen, 1978) was also discovered to be phylogenetically important as a conservative character (Hibbett and Donoghue, 1995; Ko *et al.*, 1997; McLaughlin *et al.*, 1995). However, as the ultrastructural characters are known in an insufficient number of taxa yet, it was not applied in the current analysis.

Parsimony analysis

Prepared data were analysed using the PAUP* program (Swofford, 1999). Most parsimonious trees were sought for given data sets using the heuristic search option with the following settings: simple addition sequences, TBR branch swapping, MULPARS option in effect, MAXTREES unrestricted, branches having maximum length zero collapsed to yield polytomies, multistate taxa interpreted as polymorphism, and uninformative characters ignored. When most parsimonious trees were generated, 50% majority rule consensus trees were produced using the consensus tree option. Tree statistics such as tree length and consistency index (CI), homoplasy index (HI), retention index (RI) and rescaled index (RC) were calculated. To evaluate the strength of support for branches in the parsimonious trees, 500 replicates of bootstrap resamplings (simple addition sequences, TBR branch swapping, MAXTREES 10) were performed (Felsenstein, 1985).

RESULTS AND DISCUSSIONS

Phylogenetic trees

When unrooted trees were sought with all characters treated as unweighted, most parsimonious trees based on morphological characters produced 542 steps (CI = 0.211, HI = 0.789, RI = 0.509 and RC = 0.108). However, when taxonomically important five characters were weighted twice and five times, 596 steps (CI = 0.200, HI = 0.800, RI = 0.486, RC = 0.103) and 711 steps (Fig. 1; CI = 0.202, HI = 0.798, RI= 0.521 and RC = 0.105) were produced respectively. Fig. 1 is a fifty percent majority consensus tree constructed from the case weighted five times. In terms of length and fit measures of phylogenetic trees, the more weighting is given, the longer the tree length becomes, suggesting that the tree fits worse stepwise.

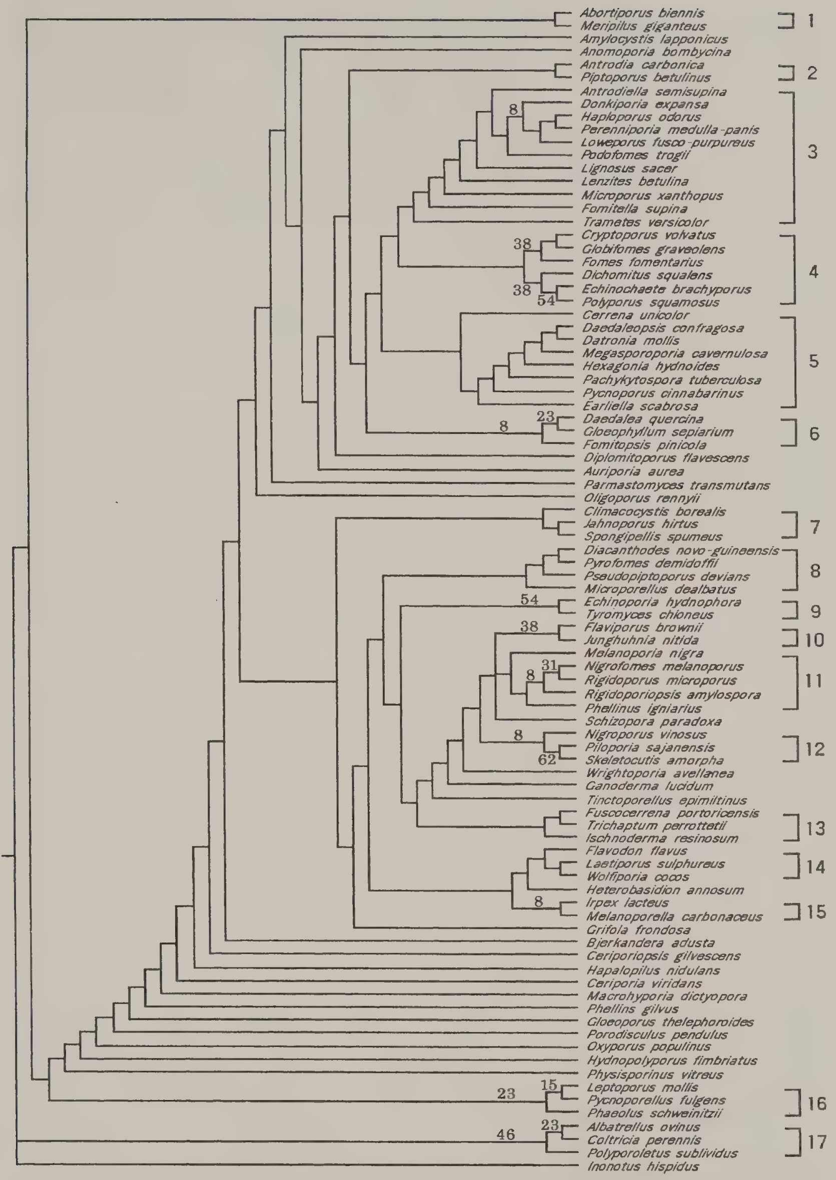
Abortiporus biennis
Meripilus giganteus
1
Amylocystis lapponicus
Anomoporia bombycina
Antrodia carbonica
Piptoporus betulinus
2
Antrodiella semisupina
8
Donkiporia expansa
Haploporus odorus
Perenniporia medulla-panis
Loweporus fusco-purpureus
Podofomes trogii
Lignosus sacer
Lenzites betulina
Microporus xanthopus
Fomitella supina
Trametes versicolor
3
38
Cryptoporus volvatus
Globifomes graveolens
Fomes fomentarius
Dichomitus squalens
38
Echinochaete brachyporus
54
Polyporus squamosus
4
Cerrena unicolor
Daedaleopsis confragosa
Datronia mollis
Megasporoporia cavernulosa
Hexagonia hydnoides
Pachykytospora tuberculosa
Pycnoporus cinnabarinus
Earliella scabrosa
5
23
Daedalea quercina
8
Gloeophyllum sepiarium
Fomitopsis pinicola
6
Diplomitoporus flavescens
Auriporia aurea
Parmastomyces transmutans
Oligoporus rennyii
Climacocystis borealis
Jahnoporus hirtus
Spongipellis spumeus
7
Diacanthodes novo-guineensis
Pyrofomes demidoffii
Pseudopiptoporus devians
Microporellus dealbatus
8
54
Echinoporia hydnophora
Tyromyces chioneus
9
38
Flaviporus brownii
Junghuhnia nitida
10
Melanoporia nigra
31
Nigrofomes melanoporus
8
Rigidoporus microporus
Rigidoporiopsis amylospora
Phellinus igniarius
11
Schizopora paradoxa
8
Nigroporus vinosus
Piloporia sajanensis
62
Skeletocutis amorpha
12
Wrightoporia avellanea
Ganoderma lucidum
Tinctoporellus epimiltinus
Fuscocerrena portoricensis
Trichaptum perrottetii
Ischnoderma resinosum
13
Flavodon flavus
Laetiporus sulphureus
Wolfiporia cocos
14
Heterobasidion annosum
8
Irpex lacteus
Melanoporella carbonaceus
15
Grifola frondosa
Bjerkandera adusta
Ceriporiopsis gilvescens
Hapalopilus nidulans
Ceriporia viridans
Macrohyporia dictyopora
Phellins gilvus
Gloeoporus thelephoroides
Porodisculus pendulus
Oxyporus populinus
Hydnopolyporus fimbriatus
Physisporinus vitreus
23
15
Leptoporus mollis
Pycnoporellus fulgens
Phaeolus schweinitzii
16
46
23
Albatrellus ovinus
Coltricia perennis
Polyporoletus sublividus
17
Inonotus hispidus

Fig. 1. Fifty percent majority consensus tree from 10 most parsimonious trees of 711 steps (CI = 0.202, HI = 0.798, RI= 0.521 and RC = 0.105) based on morphological characters of representative species in the Polyporaceae and related poroid taxa. This is an unrooted tree which was constructed using the heuristic search option of PAUP* (Swofford, 1999). Statistical supports by bootstrap resampling were shown at appropriate branches.

Trees of three cases showed both similarities and dissimilarities to one another. Some groups were steadily retained in all trees, while some groups were quite different from one another in taxonomic relationships, thus changing the tree topology greatly. Total eleven groups were identified in all three trees and were as follows: (1) *Echinochaete brachyporus* and *Polyporus squamosus*, (2) *Albatrellus ovinus* and *Coltricia perennis*, (3) *Leptoporus mollis* and *Phaeolus schweinitzii*, (4) *Pseudopiptoporus devians* and *Pyrofomes demidoffii*, (5) *Daedalea quercina* and *Gloeophyllum sepiarium*, (6) *Daedaleopsis confrogosa* and *Datronia mollis*, (7) *Cryptoporus volvatus*, *Globifomes graveolens* and *Fomes fomentarius*, (8) *Haploporus odorus* and *Perenniporia medulla-panis*, (9) *Nigroporus vinosus*, *Piloporia sajanensis* and *Skeletocutis amorpha*, (10) *Nigrofomes melanoporus* and *Rigidoporus microporus*, (11) *Echinoporia hydnoporia* and *Tyromyces chioneus*.

When the results of three trees were compared with those of other phylogenetic trees derived from molecular data of Hibbett and Donoghue (1995), Ko *et al*. (1997) and Lee and Jung (1997), the tree produced from the analysis with five characters weighted five times (Fig. 1) was most consistent with molecular data-based trees. This implies that mitic system, presence or absence of clamps, type of rot, amyloidity of spores and spore surface ornamentation are much more important characters than other taxonomic characters in inferring and revealing the true phylogenetic history of the family Polyporaceae.

Taxonomic discussions on monophyletic groups

Based on the phylogenetic tree of Fig. 1, total seventeen putatively monophyletic groups were considered and their taxonomic significances were discussed and compared with recent taxonomic or phylogenetic results.

(1) *Abortiporus biennis* and *Meripilus giganteus*: These two species have monomitic hyphal systems, smooth, inamyloid, thin-walled basidiospores, and white rot in common. However, in several aspects, they are different from each other. While *Abortiporus biennis* has stipitate basidiocarps, clamped generative hyphae, and gloeocystidia, *Meripilus giganteus* has pileate basidiocarps, simple-septate generative hyphae, and cystidioles. *Meripilus* was thought to be related to *Grifola* due to similar fruitbody morphology (Jülich, 1981; Ryvarden, 1991) but the present cladistic analysis suggested no affirmative relationship. On the other hand, two species of Group 1 were not grouped together in other cases of character weighting.

(2) *Antrodia carbonica* and *Piptoporus betulinus*: These two species are quite different in basidiocarp morphology because the former has a resupinate form and the latter a well-developed substipitate one. However, both have (di-)trimitic hyphal systems with clamped generative hyphae, smooth, thin-walled, inamyloid basidiospores, and brown rot in common. In the study of nuc-ssu and mt-ssu rDNAs (Hibbett and Thorn, 2001), *Antrodia* was included in the Polyporoid clade but, in the analysis of mt-ssu rDNAs (Ko

and Jung, 1999), *Piptoporus* was grouped together with two trimitic brown rot species, *Daedalea quercina* and *Fomitopsis pinicola* clustered in Group 6. Thus, the phylogenetic relationships of trimitic brown rotters may need another analytic study based on more molecular data.

(3) *Antrodiella semisupina*, *Donkiporia expansa*, *Haploporus odorus*, *Perenniporia medulla-panis*, *Loweporus fusco-purpureus*, *Podofomes trogii*, *Lignosus sacer*, *Lenzites betulina*, *Microporus xanthopus*, *Fomitella supina* and *Trametes versicolor*: This group is characterized by tough perennial basidiocarps, dimitic or trimitic hyphal systems with clamped generative hyphae, and white rot habit. Among the species of the group, *Antrodiella semisupina*, *Haploporus odorus*, *Lignosus sacer*, *Loweporus fusco-purpureus*, *Perenniporia medulla-panis* and *Podofomes trogii* have ellipsoid basidiospores in common.

Loweporus fusco-purpureus and *Perenniporia medulla-panis* have thick-walled spores and, along with *Haploporus odorus*, dextrinoid spores. *Fomitella supina*, *Lenzites betulina*, *Microporus xanthopus* and *Trametes versicolor* have inamyloid, cylindrical, thin-walled and smooth basidiospores. Spore surfaces are also characteristic in certain species by having echinulate (*Haploporus odorus*), warted (*Loweporus fusco-purpureus*) or truncated (*Perenniporia medulla-panis*) structures.

(4) *Cryptoporus volvatus*, *Globifomes graveolens*, *Fomes fomentarius*, *Dichomitus squalens*, *Echinochaete brachyporus* and *Polyporus squamosus*: This group has di- to trimitic hyphal systems with clamped generative hyphae, tetrapolar mating system, hyaline, thin-walled, cylindrical basidiospores, and white rot. Among them, *Echinochaete brachyporus* deviates from others by having setoid elements and colored dextrinoid hyphae. *Dichomitus* has microscopically identical characters with those of *Polyporus* and are considered to be closely related each other like the present result (Gilbertson and Ryvarden, 1986; Ryvarden, 1991; Ryvarden and Gilbertson, 1993).

(5) *Cerrena unicolor*, *Daedaleopsis confragosa*, *Datronia mollis*, *Megasporoporia cavernulosa*, *Hexagonia hydnoides*, *Pachykytospora tuberculosa*, *Pycnoporus cinnabarinus* and *Earliella scabrosa*: Like the preceding group, this group is again characterized by di- to trimitic hyphal systems with clamped generative hyphae, tetrapolar mating system, hyaline, thin-walled, cylindrical basidiospores, and white rot. Groups (4) and (5) have di- to trimitic hyphal systems with clamped generative hyphae, cylindrical basidiospores, and white rot as common characters. For that reason, Corner (1983) once insisted to merge genera of Groups (4) and (5) into one large genus *Trametes*. However, apparent phylogenetic relationships were found among *Cryptoporus*, *Daedaleopsis*, *Datronia*, *Fomes*, *Polyporus* and *Pycnoporus* of those Groups as well as *Ganoderma*, *Lentinus*, *Lenzites* and *Trametes* by the analysis of mt-ssu rDNA sequences (Hibbett and Donoghue, 1995).

(6) *Daedalea quercina*, *Gloeophyllum sepiarium* and *Fomitopsis pinicola*: This group is characterized by trimitic hyphal systems, with clamped

generative hyphae, and brown rot habit. *Gloeophyllum sepiarium* deviates from others by having colored skeletal hyphae. The relationship between *Daedalea quercina* and *Fomitopsis pinicola* was supported by the analysis of mt-ssu rDNA sequences (Hibbett and Donoghue, 1995) and by the study based on nuc-ssu and mt-ssu rDNA data (Hibbett *et al.*, 1997). *Daedalea quercina* and *Fomitopsis pinicola* were placed in the Polyporoid clade (Hibbett and Thorn, 2001) but *Gloeophyllum sepiarium* came out completely isolated from others. In this study, *Gloeophyllum* again took a unique position of its own along with those two trimitic brown rotters.

(7) *Climacocystis borealis*, *Jahnoporus hirtus* and *Spongipellis spumeus*: This group has annual pileate basidiocarps, large pores (1-2 per mm), monomitic hyphal systems of clamped generative hyphae, hyaline, inamyloid, smooth basidiospores, and white rot. *Climacocystis borealis* has ventricose hymenial cystidia, *Jahnoporus hirtus* large spindle-shaped spores, and *Spongipellis spumeus* broadly ellipsoid thick-walled spores. Morphologically, *Climacocystis* is similar to *Oligoporus* and *Spongipellis* is close to *Tyromyces* (Gilbertson and Ryvarden, 1986, 1987; Ryvarden, 1991; Ryvarden and Gilbertson, 1993, 1994) but both taxa didn't show any possible relationships with either of *Oligoporus* and *Tyromyces* in this study.

(8) *Diacanthodes novo-guineensis*, *Pyrofomes demidoffii*, *Pseudopiptoporus devians* and *Microporellus dealbatus*: This group is characterized by dimitic hyphal systems, with clamped generative hyphae, and ellipsoid dextrinoid basidiospores. Basidiocarps are pileate (*Diacanthodes novo-guineensis* and *Microporellus dealbatus*) or stipitate (*Pyrofomes demidoffii* and *Pseudopiptoporus devians*). Basidiospores of *Diacanthodes novo-guineensis*, *Pyrofomes demidoffii* and *Pseudopiptoporus devians* are colored and thick-walled. Basidiospores of *Diacanthodes novo-guineensis* (asperulate) and *Pyrofomes demidoffii* (warted) are ornamented, while those of others are smooth. Hyphae are dextrinoid (*Diacanthodes novo-guineensis*, *Pyrofomes demidoffii* and *Microporellus dealbatus*) or amyloid (*Pseudopiptoporus devians*).

For cystidia, *Diacanthodes novo-guineensis* has hymenial cystidia, while *Microporellus dealbatus* has tramal cystidia. *Diacanthodes* was suggested as a relative with *Bondarzewia* due to ornamented spores and similar hyphal system by Singer (Ryvarden, 1991). Both *Pyrofomes* and *Pseudopiptoporus* are known to be closely or distantly related to *Perenniporia* (Ryvarden, 1991), but in this study, *Perenniporia* is included in Group 3 along with other taxa with tough perennial basidiocarps.

(9) *Echinoporia hydnophora* and *Tyromyces chioneus*: These two species have dimitic hyphal systems with skeletal hyphae, clamped generative hyphae, and small, thin-walled, hyaline, globose, inamyloid basidiospores. *Echinoporia* is a strictly tropical genus and could be an unusual genus in the Polyporaceae by having distinct pileal hydnoid processes or strigose hairs from which oblong conidia that no other polypores would make are developed (Gilbertson and Ryvarden, 1986; Ryvarden, 1991).

(10) *Flaviporus brownii* and *Junghuhnia nitida*: These two species have annual, effused to reflexed basidiocarps, dimitic hyphal systems with skeletal hyphae, clamped generative hyphae, globose, thin-walled, hyaline, inamyloid, smooth basidiospores, and white rot. While *Flaviporus brownii* has hymenial cystidioles, *Junghuhnia nitida* has true cystidia. In many respects, *Flaviporus* has close relationships with the complex of *Junghuhnia* and *Antrodiella* but *Junghuhnia* has same microscopic features as *Steccherinum* (Ryvarden, 1991). Like the cladistic result of this study, *Flaviporus* and *Junghuhnia* are known to be actually identical except for yellow pore surface and tubes (Ryvarden, 1991; Ryvarden and Gilbertson, 1993).

(11) *Melanoporia nigra*, *Nigrofomes melanoporus*, *Rigidoporus microporus*, *Rigidoporiopsis amylospora* and *Phellinus igniarius*: This group has black or dark brown basidiocarps and dimitic hyphal systems with skeletal hyphae in common. Especially, *Melanoporia* and *Nigrofomes* are very characteristic in the Polyporaceae by having blackish basidiocarps along with *Melanoporiella*, *Nigroporus* and *Nigrohydnum* (Ryvarden, 1991). For other characters, some deviations exist. In rot type, *Melanoporia nigra* causing brown rot are different from the other species causing white rot. *Melanoporia nigra*, *Nigrofomes melanoporus* and *Rigidoporiopsis amylospora* have ellipsoid basidiospores, *Rigidoporus microporus* and *Phellinus igniarius* have subglobose ones, while *Rigidoporiopsis amylospora* has crested amyloid ones. On the other hand, *Melanoporia nigra* has dextrinoid skeletal hyphae and *Phellinus igniarius*, showing the xanthochroic reaction of the Hymenochaetaceae, has setae.

(12) *Nigroporus vinosus*, *Piloporia sajanensis* and *Skeletocutis amorpha*: Species in this group have brown-colored subiculum and tubes, dimitic hyphal systems with skeletal hyphae, clamped generative hyphae, allantoid, thin-walled, hyaline, smooth, inamyloid basidiospores of small size less than 5 μm in length, and white rot. Both *Piloporia sajanensis* and *Skeletocutis amorpha* have cystidioles. *Nigroporus* has blackish basidiocarps like *Melanoporia* and *Nigrofomes* of Group 11. *Piloporia* has dark brown basidiocarps with a duplex context of *Datronia* and microscopic structures of *Skeletocutis* and is believed to be intermediate between *Datronia* and *Skeletocutis* (Ryvarden, 1991).

(13) *Fuscocerrena portoricensis*, *Trichaptum perrottetii* and *Ischnoderma resinosum*: Species of this group have dimitic hyphal systems with skeletal hyphae, clamped generative hyphae, thin-walled, inamyloid, hyaline, smooth, cylindrical basidiospores of 5-7 μm in size, and white rot. Both *Fuscocerrena* and *Trichaptum* have apically encrusted cystidia. Especially, *Fuscocerrena* has dark basidiocarps with dendrohyphidia and *Ishnoderma* dark brown tomentose pilei turning black and glabrous on aging. They resemble *Datronia* of Group 5 as the closest relative (Ryvarden, 1991). But *Trichaptum* has been constantly reported as a hymenochaetoid member in the conclusions of recent molecular studies (Hibbett and Donoghue, 1995; Hibbett and Thorn, 2001; Kim and Jung, 2000; Ko *et al.*, 1997).

(14) *Flavodon flavus, Laetiporus sulphureus* and *Wolfiporia cocos*: This

group has hyaline, smooth, inamyloid, thin-walled basidiospores, and dimitic hyphal systems with simple-septate generative hyphae. However, *Laetiporus sulphureus* with binding hyphae is different from *Flavodon flavus* and *Wolfiporia cocos* with skeletal hyphae. While *Laetiporus sulphureus* and *Wolfiporia cocos* are brown rotters, *Flavodon flavus* is a white rotter. *Wolfiporia cocos* has distinctive inflated hyphae and *Flavodon flavus* has apically encrusted hymenial cystidia.

However, *Laetiporus sulphureus* continuously formed a monophyletic group with a colored brown rotter, *Phaeolus schweinitzii* of Group 16, in phylogenetic trees based on nuc-ssu and/or mt-ssu rDNA sequence data (Hibbett and Donoghue, 1995; Hibbett and Thorn, 2001; Kim and Jung, 2000; Ko *et al.*, 1997; Ko and Jung, 1999a). There seems to be no confident evidence that *Laetiporus* is related to the Hymenochaetaceae and, based on molecular data, *Laetiporus* was grouped together with *Phaeolus*, *Sparassis* (Hibbett *et al.*, 1997) and *Wolfiporia* (Kim and Jung, 2000) and formed a different lineage from other taxa, suggesting that they form a phylogenetic group of their own at a family level.

(15) *Irpex lacteus* and *Melanoporella carbonaceus*: This group has dimitic hyphal systems with skeletal hyphae, simple-septate generative hyphae, inamyloid, smooth, hyaline, thin-walled basidiospores of 5-7 *μ*m in size, and white rot. However, *Irpex* is closely related to *Junghuhnia* of Group 10 except for the absence of clamps. *Melanoporella* has colored generative hyphae, black contexts and tubes, which features are shared by *Melanoporia* and *Nigrofomes* with blackish basidiocarps of Group 11.

(16) *Leptoporus mollis, Pycnoporellus fulgens* and *Phaeolus schweinitzii*: This group is characterized by annual basidiocarps, mono- to dimitic hyphal systems with simple-septate generative hyphae, and brown rot. Among them, the relatedness between *Laetiporus sulphureus* and *Phaeolus schweinitzii* was revealed by molecular data as cited in Group 14. *Phaeolus schweinitzii* has been classified in the Hymenochaetaceae due to rusty brown basidiocarps permanently darkening in KOH. Nevertheless, *Phaeolus* has cystidia instead of setae, lacks imperforate parenthosomes (Moore, 1980), and causes brown rot, indicating that it has no direct relationship to the Hymenochaetaceae. On the other hand, *Pycnoporellus*, another colored brown rotter, was suggested as probably related to *Phaeolus* (Gilbertson and Ryvarden, 1987; Ryvarden, 1991), which fact corresponds to the result of this study.

(17) *Albatrellus ovinus, Coltricia perennis* and *Polyporoletus sublividus*: This group is characterized by annual, stipitate basidiocarps and monomitic hyphal systems with simple-septate generative hyphae. Species in this group are terrestrial and do not decay wood. When characters unique to each species are considered, this group does not seem to form a reasonable cluster. Taxonomically, *Albatrellus ovinus* is accepted in the Albatrellaceae (Pouzar, 1966; Ryvarden, 1991) and has amyloid hyphae. *Coltricia perennis* is accepted in the Hymenochaetaceae by characteristic setae and xanthochroic reaction

and also has colored dextrinoid hyphae. *Polyporoletus sublividus* is accepted in the Polyporaceae and is morphologically similar to the species of *Albatrellus* but has thick-walled unique basidiospores which are similar to those of *Ganoderma* (Gilbertson and Ryvarden, 1987).

Taxonomic considerations on residual taxa

In addition to above-discussed monophyletic Groups, there are some cladistically residual taxa. *Inonotus hispidus* of the Hymenochaetaceae formed a basal taxon to the tree and was topologically close to Group 17. However, this species made a monophyletic group with *Trichaptum* in the study of nuc-ssu rDNA sequences (Ko *et al.*, 1997) and was actually nested inside the Hymenochaetoid clade based on nuc-ssu and mt-ssu rDNA data (Hibbett and Thorn, 2001), suggesting that it is phylogenetically a good hymenochaetoid member. The same goes for *Coltricia perennis* of Group 17 which is grouped within the Hymenochaetoid clade (Hibbett and Thorn, 2001) and for *Phellinus gilvus* between Groups 15 and 16 which is included in the Hymenochaetaceae (Hibbett and Donoghue, 1995).

On the other hand, in comparison with the results of Hibbett and Thorn (2001), *Phellinus igniarius* of the Hymenochaetoid clade is included in Group 11 along with *Melanoporia*, *Nigrofomes*, *Rigidoporus* and *Rigidoporiopsis*. Likewise, *Phaeolus schweinitzii* of the Polyporoid clade is assorted in Group 16 together with *Leptoporus* and *Pycnoporellus*. Thus, the present cladistic analysis based on morphological characters clearly split the Hymeochaetaceae Donk or the Hymenochaetales Oberw. into several phylogenetic groups or taxa as normally conceived by taxonomists.

Schizopora paradoxa present between Groups 11 and 12 has a position of its own and is taxonomically unique because it has microscopic features of *Hyphodontia* (Ryvarden, 1991; Langer, 1994) and imperforate parenthosomes for septal ultrastructure like the members of the Hymenochaetaceae (*Phellinus*, *Inonotus* and *Onnia*), *Trichaptum* and *Hyphodontia* (Moore, 1980, 1985; Traquair and McKeen, 1978; Langer 1994). *Schizopora* is apparently related with hymenochaetoid members and, according to rDNA analysis, properly included in the Hymenochaetoid clade (Hibbett and Thorn, 2001).

Ganoderma lucidum occurring between Groups 12 and 13 is the type species of the Ganodermataceae that was split from the Polyporaceae by Donk (1964) on the basis of double-walled and truncated basidiospores with ornamented inner walls. However, such a spore character was considered as an apomorphic trait derived from smooth spores within the Polyporaceae and the family concept of the Ganodermataceae is in need of reconsideration (Hibbett and Donoghue, 1995). *Ganoderma* was phylogenetically included in the *Trametes* Group (Ko and Jung, 1999a), in the Polyporaceae (Kim and Jung, 2000) or in the Polyporoid clade (Hibbett and Thorn, 2001), and proved to be a good polyporoid genus.

Heterobasidion annosum is placed between Groups 14 and 15. However, this species has been phylogenetically unusual because it used to be grouped with taxa in possession of spores with amyloid ornamentations (Hibbett and Donoghue, 1995; Hibbett and Thorn, 2001; Kim and Jung, 2000; Ko *et al.*, 1997; Lee and Jung, 1997). According to the molecular result of Kim and Jung (2000), it came out as closely related to the families Hericiaceae Donk (1964) and Amylostereaceae Boidin *et al.* (1998). Hibbett and Thorn (2001) included it in the Russuloid clade mostly composed of taxa with amyloid spores and gloeoplerous cystidia or hyphae.

Grifola frondosa came differently out of monophyletically grouped taxa. *Meripilus* of Group 1 was once suggested to be related to *Grifola* due to morphologically similar basidiocarps differing only in the septation of generative hyphae (Jülich, 1981; Kim and Jung, 1999; Ryvarden, 1991; Pouzar, 1966), but more phylogenetic findings are required for conclusive discussions. *Bjerkandera adusta* is also independent in tree topology but traditionally has been treated as a good polyporoid member. In the ITS analysis of Boidin *et al.* (1998), it came within the Phanérochaetales Jülich (1981) along with *Phanaerochaete*, *Ceriporia* and *Phlebia*. But this group of a new order level definitely belonged to the Polyporoid clade, forming a separate lineage within the clade, in the nuc-ssu and mt-ssu rDNA analysis by Hibbett and Thorn (2001).

Hapalopilus nidulans is unique in having polyporic acid (Ryvarden, 1991) and has a position isolated from other polyporoid members of the present study but, based on recent mt-ssu rDNA analysis, was reported to form a member of the main *Hapalopilus* group that is directly connected to the *Trametes-Polyporus* group (Ko *et al.*, 2001). *Ceriporiopsis gilvescens* and *Ceriporia viridans* came out separately each without forming any group with other members. Nevertheless, in the results of Boidin *et al.* (1998), *Ceriporiopsis* was included in the Phlébiales Boidin *et al.* (1998) and *Ceriporia* in the Phanérochaetales Jülich (1981), suggesting that there is no actual relationship between those two taxa, but the latter genus was apparently close enough to *Bjerkandera* to form an individual lineage together right in the Polyporoid clade of Hibbett and Thorn (2001).

Oxyporus populinus also appeared to be independent but, according to the results of mt-ssu rDNA analysis (Kim and Jung, 1999; Ko and Jung, 1999b), another species of *Oxyporus*, *O. latemarginatus*, is closely related to *Ceriporia* species. Macro- and microscopically, *Oxyporus* and *Ceriporia* are rather similar each other except for pore surface colors and cystidia (Ryvarden and Gilbertson, 1993, 1994). Jülich (1981) classified both of them in the Rigidoporaceae and Ryvarden (1991) in the *Rigidoporus* group, suggesting their close relationships. However, contrary to the result of Kim and Jung (1999), there is another unknown *Oxyporus* species coupled as a sister taxon with *Schizopora* in the Hymenochaetoid clade of Hibbett and Thorn (2001), which indicates a possibility that *Oxyporus* itself could be polyphyletic.

For other remaining taxa, there seem to be no appropriate phylogenetic results based on sequence data yet and little can be compared or discussed enough until sufficient molecular data become available from more diverse groups of polyporoid taxa.

General conclusions

The initial purpose of this cladistic analysis was to analyze the polyphyletic family Polyporaceae into smaller and putatively more natural taxa and, to accomplish such an analysis, morphological characters commonly used in taxonomic descriptions were utilized. In most studies of cladistic analyses, treating all characters as unordered are widely used (Hibbett and Vilgalys, 1993; Langer, 1994; Parmasto, 1995; Vilgalys, 1986). As this treatment assumes no hypothesis on character evolution, it used to be regarded as an objective and safe approach. However, its defect is that some useful informations are lost, thus making less characterized trees. Some cladistic analyses adopt hypothesized character types, when mode of character evolution was quite clear (McLaghlin *et al.*, 1995; Zeller, 1995).

Weighting is known to be one of the most difficult parts in the cladistic analysis of morphological data (Forey *et al.*, 1992; Swofford, 1999; Wiley *et al.*, 1991). At the first glance, no weight could be the most rational choice. However, the real situation demands different choices. Some nucleotide sequence data on polyporoid groups are now available and can be retrieved from the GenBank. Analyses of molecular data afforded practical help in determining character weights in the present data analysis. Some characters were phylogenetically more important than other characters. Mitic system, presence or absence of clamps, type of rot, spore surface ornamentation and amyloidity of spores were such examples.

The importance of those characters used to be emphasized by many authors especially among morphological taxonomists (Donk 1964; Furtado, 1966; Ryvarden, 1991; Teixeira, 1962). Recent molecular works on the Polyporaceae and related taxa (Hibbett and Donoghue, 1995; Hibbett and Thorn, 2001; Ko *et al.*, 1997; Lee and Jung, 1997; Kim and Jung, 2000) also proved that mitic system, presence or absence of clamps, rot type and spore amyloidity were very important characters of phylogenetic significance. Determination of the absolute value of weighting for the present analysis was actually based on the molecular phylogenetic results of Hibbett and Donoghue (1995). The structure of a septal pore cap (parenthosome) was also discovered to be phylogenetically important (Hibbett and Donoghue, 1995; Ko *et al.*, 1997; McLaughlin *et al.*, 1995; Hibbett and Thorn, 2001). However, as the ultrastructural characters are known only in a limited number of taxa, it was not applied in the current analysis.

How much weight might be given on more important characters or how much relative weight will be given on each character is in fact a personal choice. From the present study using some well-known characters of taxonomic importance weighted five times, 17 monophyletic groups of phylogenetic significance were putatively recognized and discussed in relation with cladistically residual taxa. The more weights were given on taxonomically important characters, it was proved that the more significant influences were exercised on tree topologies and the more similar results to those of molecular works were expected.

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PHYLOGENETIC EVALUATION OF POLYPORUS S. STR. BASED ON MOLECULAR SEQUENCES

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ABSTRACT

To investigate phylogenetic relationships of *Polyporus* species, partial mitochondrial small subunit ribosomal DNA sequences were determined and phylogenetically analyzed. *Polyporus* species used in the study did not cluster into a single clade. Six species formed one clade with *Datronia* species. *Polyporus arcularius* clustered with two *Lentinus* species and *Fomes fomentarius*. Statistical test rejected the monophyly of *Polyporus* but supported *Polyporus*, *Datronia*, *Lentinus* and *Fomes* as a group.

Key words: *Datronia, Fomes, Lentinus*, phylogeny

INTRODUCTION

Polyporus, type genus of the family Polyporaceae, includes pore fungi with stipitate to substipitate basidiocarps. It is characterized and defined in a strict sense by a dimitic hyphal system with skeleto-binding hyphae. Its basidiospores are hyaline, smooth, cylindrical to subellipsoid and non-amyloid. It shows tetrapolar mating type and develops white rot. It has been divided into five or six morphological groups, which sometimes used to be given rank of genera (Gilbertson and Ryvarden, 1987; Núñez and Ryvarden, 1995; Ryvarden and Gilbertson, 1994); *Polyporus*, *Favolus*, *Melanopus*, *Polyporellus* and *Dendropolyporus*. Each genus can be recognized by its particular morphology and consistency of basidiocarps.

However, the phylogenetic position and relationship of *Polyporus* were not clear so far. Many mycologists included it in the order Aphyllophorales as it has gymnocarpic basidiocarp development and complex hyphal systems (Donk, 1964; Gilbertson and Ryvarden, 1987; Ryvarden and Gilbertson, 1994). On the other hand, others (Corner, 1984; Singer, 1986) preferred to place it in the order Agaricales because of similarities of *Polyporus* and gilled agaric genera *Lentinus, Panus* and *Pleurotus* in basidiocarp consistency.

In this study, partial mitochondrial small subunit ribosomal DNA (mt-ssu rDNA) was selected as a molecular marker to evaluate the phylogeny of *Polyporus*. Mitochondrial rDNA sequences have been used in some fungal phylogenetic studies (Hibbett and Donoghue, 1995; Cullings *et al.*, 1996; Bruns *et al.*, 1998; Ko and Jung, 1999a, 1999b) and shown to be adequate for the evaluation of phylogenetic relationships within or among taxa at genus level (Ko and Jung, 1999a, 1999b).

MATERIALS AND METHODS

Species and strains used in this study and their GenBank accession numbers are listed in Table 1. Cultures were performed on malt extract broth, harvested, lyophilized and ground to powder. Herbarium specimens were visually examined and a minute piece from the internal portion of specimen was taken and ground to powder. Total DNAs were extracted from samples by a rapid method of freeze-and-thawing (Lecellier and Silar, 1994; Ko and Jung, 1999b; Lee *et al.*, 2000). PCR amplification for the mt-ssu rDNA region was executed using a primer set, MS1 and MS2 (White *et al.*, 1990). Amplified PCR products were detected on agarose gel and purified using a PCR purification kit (I.J. BIO). Direct sequencing reactions were employed for the thermal cyclic termination method with ^{35}S-labeled ATP (Hillis *et al.*, 1996) using the *Top*™ DNA sequencing kit (Bioneer Corp.) according to manufacturer's instructions. Primers in amplification were also used in direct sequencing.

Total 32 partial mt-ssu rDNA sequences generated in this study and retrieved from GenBank were submitted to phylogenetic analyses. Multiple sequence alignments were accomplished using CLUSTAL X (Thompson *et al.*, 1997). Ambiguously aligned regions were omitted and manually adjusted sequences were submitted to following phylogenetic analyses. Phylogenetic trees were constructed using neighbor-joining and parsimony methods of PAUP* 4.0b4a (Swofford, 1999). For the neighbor-joining method, pairwise distances were calculated using the maximum likelihood option. For the parsimony method, heuristic search was conducted using the option of tree bisection reconstruction (TBR) branch swapping. Statistical supports for branches found in distance and parsimony analyses were evaluated from 500 bootstrap replications (Felsenstein, 1985; Hillis and Bull, 1993). Constraint trees were generated using MacClade 3.04 (Maddision and Maddison, 1993) and PAUP* 4.0b4a (Swofford, 1999).

Table 1. Species and strains used in this study.

Species name	Strain number	Accession
Coriolopsis gallica (Fr.) Ryv.	CBS 576.88 (KCTC[1] 6864)	AF042151
Cryptoporus volvatus (Pk.) Shear	DAOM 21179	U27031
Daedaleopsis confragosa (Bolt.: Fr.) Schroet.	CBS 445.61 (KCTC 16012)	AF039576
Daedaleopsis tricolor (Pers.) Bond. & Sing.	CBS 241.36 (KCTC 16022)	AF042322
Datronia mollis (Sommerf.: Fr.) Donk	DAOM 21179	U27033
Datronia scutellata (Schw.) Gilbn. & Ryv.	CBS 459.66 (KCTC 16005)	**AF358731**
Dentocorticium sulphurellum (Peck) Larsen & Gilbn.	FPL 11801	AF026647
Fomes fomentarius (Fr.) Fr.	DAOM 12903	U27036
Ganoderma lucidum (W. Curt.: Fr.) Karst.	SAR s.n.	U27040
Laetiporus sulphureus (Bull.: Fr.) Murr.	DSH-93-184	U27049
Lentinus crinitus (L.: Fr.) Fr.	CBS 173.86 (IMSNU[2] 32225)	**AF358732**
Lentinus tigrinus (Bull.: Fr.) Fr.	DSH 93-181	U27050
Lenzites betulina (Fr.) Fr.	DSH 180504	U27045
Megasporoporia hexagonoides (Speg.) Wright & Rajch.	CBS 511.92 (KCTC 6847)	AF042323
Microporus vernicipes (Berk.) Kuntze	SFC[3] 971030-9	**AF358733**
Polyporus alveolaris (DC.: Fr.) Bond. & Sing.	SFC 960611-14	**AF358734**
Polyporus arcularius Batsch: Fr.	SFC 980514-12	**AF358735**
	SFC 980910-3	**AF358736**
	DSH 92-144	U27055
Polyporus melanopus Fr.	DAOM 21226	U27062
Polyporus squamosus Huds.: Fr.	LR 27136	**AF358737**
	LR 24031	**AF358738**
	FPL 6846	U27068
Polyporus tuberaster Jacq.: Fr.	MN-622	**AF358739**
	n. 1419A Bernicchia	**AF358740**
	DAOM 7997B	U27070
Polyporus umbellatus Fr.	nr 167	**AF358741**
Polyporus varius Fr.	LR 25319	**AF358742**
	DSH 93-195	U27072
Pycnoporus cinnabarinus (Jacq.: Fr.) Karst.	SFC 980514-15	**AF358743**
Trametes trogii Berk.	DAOM 72399	**AF358744**
Trametes versicolor (L.: Fr.) Pilát	CBS 292.33	AF042324

Accession numbers in bold types are those for strains sequenced in this study.

[1] Korean Collection for Type Cultures.

[2] Institute of Microbiology, Seoul National University.

[3] Seoul National University Fungus Collection.

RESULTS AND DISCUSSISON

As a result of multiple alignments using CLUSTAL X (Thompson *et al.*, 1997), 490 aligned nucleotides of mt-ssu rDNAs were generated after manual editing and submitted to phylogenetic analyses. The phylogenetic tree in Fig. 1 was constructed and phylogenetic relationships of *Polyporus* and related taxa were inferred by the parsimony method. The result by the neighbor-joining method was not significantly different from the topology by the parsimony method (Fig. 1).

Phylogenetic studies including this one have shown that *Polyporus* has close relationships with the *Trametes* group *sensu* Ryvarden (1991) and is merged into the core group (Hibbett and Donoghue, 1995) or the main clade (Ko and Jung, 1999b) of the Polyporaceae. In general, this core group or main clade suggested for the future revision of the family includes trimitic trametoid fungi with hyaline, smooth, cylindrical, non-amyloid spores, white rot habit, and a tetrapolar mating system (Ryvarden, 1991; Hibbett and Donoghue, 1995). *Polyporus* has similar microscopic features to those of trametoid fungi except for the dimitic hyphal system with skeleto-binding hyphae (Gilbertson and Ryvarden, 1987; Núñez and Ryvarden, 1995; Ryvarden and Gilbertson, 1994). According to recent studies, *Lentinus* species and *Fomes fomentarius* were included in the core group (Hibbett and Donoghue, 1995) but *Pleurotus* and *Panus*, which have been considered as closely related to *Polyporus* or *Lentinus*, clustered into other groups respectively (Hibbett *et al.*, 1997; Ko and Jung, 1999a).

In Fig. 1, six species of *Polyporu*s were clustered into one clade with two *Datronia* species (Group I). However, *P. arcularius* was grouped with *Lentinus crinitus* and these two species had close relationships with *L. tigrinus* and *Fomes fomentarius* (Group II). *Polyporus squamosus* and *P. alveolaris* clustered into a same clade, which was congruent with the result of Hibbett and Vilgalys (1993), by high bootstrap support. These two species formed a group with two *Datronia* species, *D. mollis* and *D. scutellata* (68 and 86 % of bootstrap values in parsimony and neighbor-joining methods, respectively). This clade was connected with *P. melanopus*, *P. varius*, *P. tuberaster* and then *P. umbellatus* sequentially, but their bootstrap values were not so significant.

The genus *Polyporus* has been divided into five or six morphological groups (Gilbertson and Ryvarden, 1987; Ryvarden and Gilbertson, 1994; Núñez and Ryvarden, 1995). Among the studied species, *P. squamosus* and *P. tuberaster* belong to group *Polyporus*. *Polyporus alveolaris* with non-inflated skeleto-binding hyphae is included into group *Favolus*. *Polyporus melanopus* and *P. varius* are included into group *Melanopus* characterized by the black cuticle of stipe and the narrow solid skeleto-binding hyphae. *Polyporus arcularius* is included into group *Polyporellus* and *P. umbellatus* into group *Dendropolyporus.* Their groupings, however, were not congruent with the results of this study. For example, *P. squamosus* of group *Polyporus* is microscopically identical with *P. tuberaster* of the same group (personal communication with Ryvarden) but came out to be closely related to *P. alveolaris* of group *Favolus*.

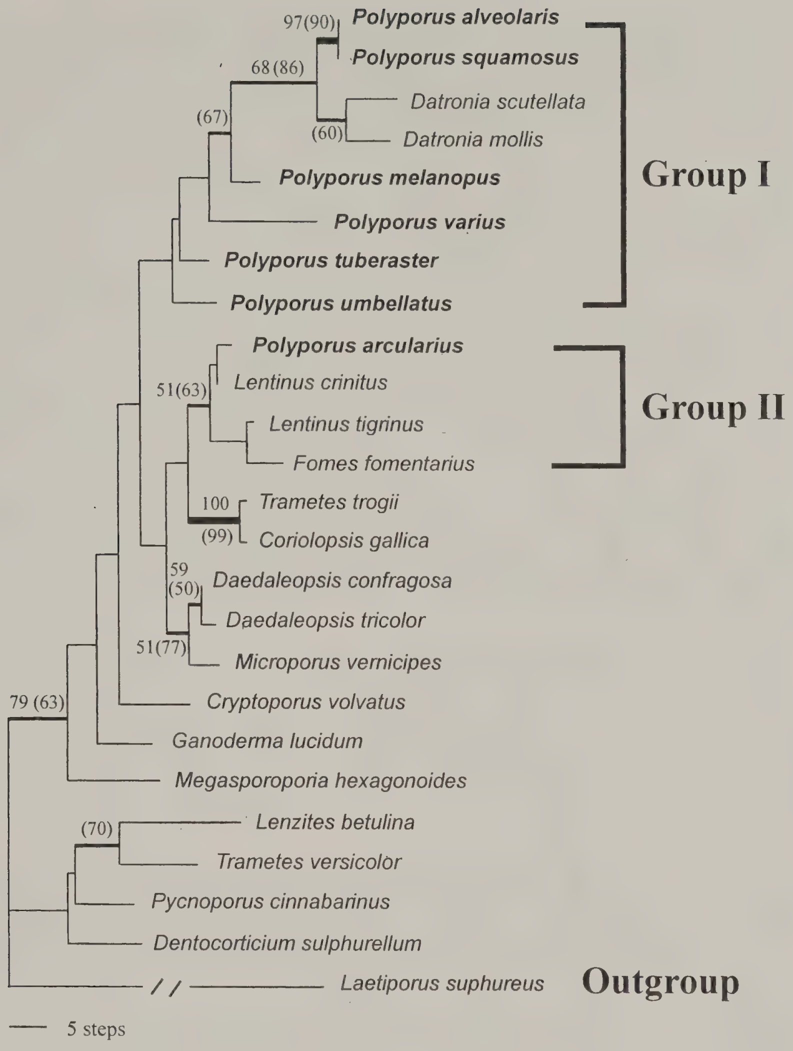
97(90)
Polyporus alveolaris
Polyporus squamosus
68 (86)
Datronia scutellata
(67)
(60)
Datronia mollis
Polyporus melanopus
Polyporus varius
Polyporus tuberaster
Polyporus umbellatus
Group I
Polyporus arcularius
51(63)
Lentinus crinitus
Lentinus tigrinus
Fomes fomentarius
Group II
100
Trametes trogii
(99)
Coriolopsis gallica
59
(50)
Daedaleopsis confragosa
Daedaleopsis tricolor
51(77)
Microporus vernicipes
Cryptoporus volvatus
79 (63)
Ganoderma lucidum
Megasporoporia hexagonoides
(70)
Lenzites betulina
Trametes versicolor
Pycnoporus cinnabarinus
Dentocorticium sulphurellum
Laetiporus suphureus
Outgroup
5 steps

Fig. 1. Phylogenetic relationships of *Polyporus* and related taxa inferred from partial mt-ssu rDNA sequences. This tree was deduced by the parsimony method (tree length = 300 steps, CI = 0.6700, HI = 0.3300, RI = 0.5976, RC = 0.4004), which showed similar topology to that of the neighbor-joining method. *Polyporus* species are indicated in boldface. Bootstrap values were shown at branches supported by mor than 50% from 500 replications and those by the neighbor-joining method were put in parentheses. Bold lines were used where branches were supported by more than 50% but below 90% and thick lines where significantly supported by more than 90%.

To test whether *Polyporus* is monophyletic or not, several constraint trees were generated using MacClade 3.04 (Maddison and Maddison, 1993) and PAUP* 4.0b4a (Swofford, 1999). These hypotheses were submitted to Kishino-Hasegawa test (Kishino and Hasegawa, 1989). The tested results are presented in Table 2 and indicated that *Polyporus* is not monophyletic. However, the hypotheses that constrained *Polyporus* to which *Datronia*, *Lentinus* and *Fomes* were successively added were not significantly worse than the best tree (Table 2) and thus were not rejected.

Datronia, which clustered with *P. squamosus* and *P. alveolaris*, was included into the *Trametes* group by Ryvarden (1991). *Datronia* has a di- or trimitic hyphal system without true binding hyphae (Ryvarden and Gilbertson, 1994), which is different from other members of the *Trametes* group. Its dimitic hyphal system with colored skeletal hyphae (Ryvarden, 1991) is also different from that of *Polyporu*s with skeleto-binding hyphae (Núñez and Ryvarden, 1995). Ryvarden and Gilbertson (1994) suggested that *Datronia* is related to *Coriolopsis* due to shared colored skeletal hyphae. In this study, however, *Coriolopsis gallica* was connected to *Trametes trogii* and, in another study (data not shown), *C. polyzona* (type species of *Coriolopsis*) proved to have a close relationship with *T. versicolor* complex. The close relationship between *Datronia* and *Polyporus* may serve as one of examples that indicate parallelism of hyphal systems in the evolution of fungi.

The phylogenetic position of *Lentinus* has been reported to be problematic (Hibbett and Vilgalys, 1991, 1993; Pegler, 1983; Singer, 1986). Two *Lentinus* species included in this study were found to be closely related to *P. arcularius* and *F. fomentarius* (Fig. 1).

Table 2. Results of the Kishino-Hasegawa test.

Trees	Tree Length	–ln L	Differences[1]	SD[2]	T[3]	Rejected?[4]
MP phylogeny	300	2349.797	best	-	-	-
P	321	2425.979	76.182	25.353	3.00	Yes
P+D	310	2382.423	32.626	21.801	1.50	No
P+D+L	313	2379.267	29.470	22.772	1.29	No
P+D+L+F	310	2373.707	23.910	18.133	1.32	No

P stands for *Polyporus,* D for *Datronia,* L for *Lentinus,* and F for *Fomes.*

[1] Difference in log likelihood compared to that of the best tree.

[2] The standard deviation of log likelihood.

[3] Value that differences were divided by SD.

[4] The difference is considered significantly worse than the best tree if the T value is more than 1.96.

According to Hibbett and Vilgalys (1993), *Lentinus* species did not form one group. In this study, *L. tigrinus* and *L. crinitus* showed close relationships with *Polyporus*. *Lentinus* species that clustered with *P. arcularius* represented the *Lentinus* subgenus *Lentinus* with ligative hyphae and hyphal pegs (Pegler, 1983). And *Fomes* is characterized by large spores and granular core consisting of distinctive sclerids (Gilbertson and Ryvarden, 1987; Ryvarden, 1991). However, according to the result of the present study (Fig. 1), *Lentinus* and *Fomes* apparently have close relationships with *P. arcularius*. The statistical test (Table 2) also suggested that they could be categorized into a same phylogenetic group with *Polyporus*.

In conclusion, the genus *Polyporus* is not monophyletic and is closely related to the *Trametes* group with trimitic hyphal systems and white rot habit. Thus, the genus concept of *Polyporus* needs to be redefined from the phylogenetic point of view and taxonomically needs to be expanded by including more taxa from *Datronia*, part of *Lentinus*, and *Fomes*.

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NEW RECORDS OF RAMARIOPSIS FROM MEXICO

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Abstract

Four species and one form are reported as new records of the genus *Ramariopsis* for Mexico, *Ramariopsis corniculata*, *R. fusiformis*, *R. laeticolor*, *R. laeticolor* f. *bulbispora* and *R. pulchella*. Taxonomic descriptions and commentaries are included for each species, and an overall discussion and commentaries about the genus taxonomy and its knowledge in Mexico is provided.

Key words: Aphyllophorales, Clavariaceae, taxonomy, biodiversity.

INTRODUCTION

The genus *Ramariopsis* was first described by Corner (1950) who separated from the genus *Clavaria* those species having branched fruit bodies, whitish colors and spiny hyaline spores. Petersen (1966, 1969 & 1978) proposed an emendation in order to include species with smooth spores and simple fruit bodies. At present, no consensus exists regarding the taxonomic delimitation of the genus (Hawksworth *et al.*,1995; Jülich, 1981 & 1985), and there is no precise estimate of the number of species in the genus.

The present contribution is the first phase of a broader work on the phylogenetic systematics of the genus *Ramariopsis* carried out by the first author.

Prior to the realization of the present paper, only three records of *Ramariopsis* species in Mexico existed, mainly as part of local or regional lists, but only *R. kunzei* constitutes a valid record. In the other records, the samples belong to species of the genus *Clavaria*.

Species	**Reported as**	**Reported by**
Ramariopsis corniculata (Fr.) Petersen	*Clavulinopsis corniculata* (Fr.) Corner	Portugal *et al.*, 1985; Varela & Cifuentes, 1979
Ramariopsis fusiformis (Sow.: Fr.) Petersen	*Clavulinopsis fusiformis* (Sow.:Fr.) Corner	Moreno-Fuentes *et al.*, 1994
Ramariopsis kunzei (Fr.) Corner	*Ramariopsis kunzei* (Fr.) Corner	García-Romero *et al.*, 1970

Table 1: Species of the *Ramariopsis* genus reported from Mexico, previously to the present paper.

An exhaustive review of the major Mexican mycological collections was made, taking into consideration all samples labeled as *Ramariopsis* and allied genera (*Clavaria* and *Clavulinopsis*). The scientific collections reviewed were: Herbarium of the Faculty of Sciences, UNAM (FCME); Herbarium of the National School of Biological Sciences, IPN (ENCB); The Mexican National Herbarium of the Institute of Biology, UNAM (MEXU); Herbarium of the Autonomous University of Tlaxcala (TLXM), and Herbarium of the Institute of Botany of the University of Guadalajara (IBUG). In addition, a review of the samples previously reported from Mexico belonging to *Ramariopsis* was made to assess the validity of the taxonomic determination.

The taxonomic determination was made using the monographic works of Corner (1950 & 1970) and Petersen (1964, 1966, 1978 & 1988). For the taxonomic genus ranking we followed the proposal of Petersen (1978). Observations were made using common mycological techniques (Cifuentes *et al.*, 1986; Largent *et al.*, 1980). Color descriptions were made with reference to standardized color charts (Kornerup & Wanscher, 1978).

TAXONOMICAL DESCRIPTIONS

Ramariopsis corniculata (Schaeff.: Fr.) Petersen. 1978. **Mycologia 70:** 668.

≡*Clavaria corniculata* Schaeff.: Fr. 1821. **Syst. Mycol. 1:** 471.
≡*Clavulinopsis corniculata* (Schaeff.: Fr.) Corner. 1950. **Ann. Bot. Mem. 1** : 362.
≡*Ramaria corniculata* (Schaeff.: Fr.) Gray. 1821. **Nat. Arr. Br. Pl. 1:** 665.
≡*Donkella corniculata* (Schaeff.: Fr.) Doty. 1950. **Lloydia 13:** 14.

Pl. **1**, Fig. **c**; Pl. **2**, Fig. **a**.

Fruit bodies up to 65mm high, branched on one or two levels; branchs mainly dichotomous, sometimes polychotomous; axils irregular and acutely angled below and rounded upward, observable even in dried samples; growing on small whitish mycelial patches; fruit bodies medlar yellow (Methuen 5B6) to deep yellow (Methuen 4A8) on the upper side, deep yellow (Methuen 4A8) to medlar yellow (Methuen 5B6) on medium side, and bright yellow (Methuen 4A5) to corn yellow (Methuen 3A2) on the apices; branches mainly terete, just a few flattened, apices rounded to slightly acute. Context solid, whitish yellow (Methuen 3A2) to concolorous outward; consistency cartilaginous to the merge and fleshy fibrous to the center. Stipe clearly differentiated, up to 35mm high, and 6mm wide, some flattened, occasionally with a white tomentum. Odorless and tasteless or astringent in a few.

Positive reaction to FeSO4 on hymenium, changing to greenish gray or greenish blue immediately, even on dried samples.

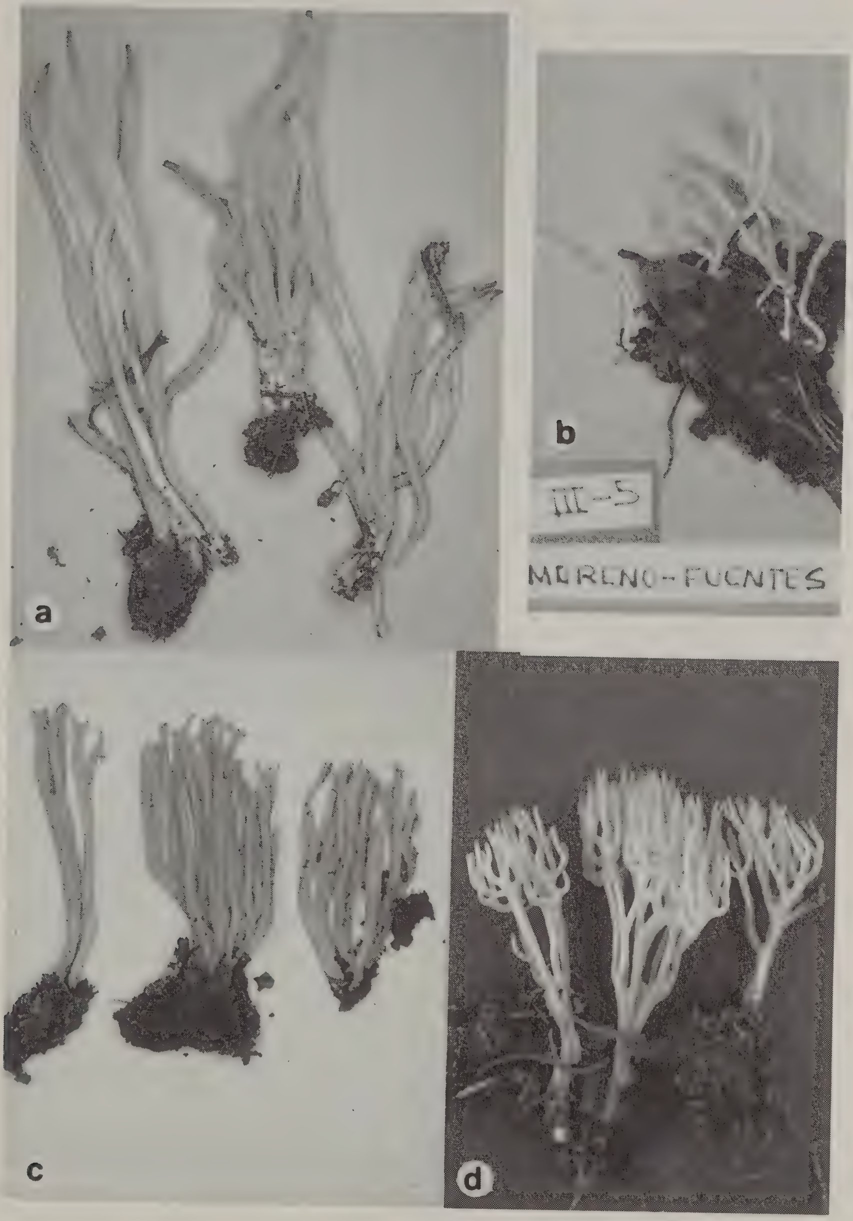
a
b
III-5
MORENO-FUENTES
c
d

Plate 1: **a)** *Ramariopsis fusiformis;* **b)**, *Ramariopsis laeticolor;* **c)** *Ramariopsis corniculata;* **d)** *Ramariopsis pulchella.*

Tramal hyphae monomitic, parallel, agglutinated, clamped, some inflated hyphae up to 9.8µm wide; hyphae with walls slightly thickened downward to the base of the stipe. Subhymenial hyphae thin and loosely interwoven. Hymenium thickened; basidia on simple clubs, four spored, clamped, with straight sterigmata.

Spores 4.9-7 x (4.2)4.9-7µm, globose to slightly subglobose, hyaline, walls slightly thickened, uniguttulate, smooth at 1000x; hilar appendix prominent.

Fruit bodies cespitose to gregarious, terricolous. On oak forest or rain forest.

Commentary

This species has previously been reported in Mexico in the States of Hidalgo (Varela & Cifuentes, 1979) and Morelos (Portugal *et al.*, 1985), but a more extensive survey of the samples belonging to these records has shown that they do not belong to this species. In the case of the record of Hidalgo State (**Pérez-Ramírez 1450**) this presents simple club shaped fruit bodies, unclamped with elongated spores and exhibiting a negative reaction to iron salts. These features lead us to *Clavaria* as the correct taxonomical determination for this sample. The record from Morelos State (**Portugal 305**) shows branched lignicolous fruit bodies, with elipsoid wrinkled spores of cyanophilous ornamentation. Based on these features we can place it within the genus *Ramaria* subgenus *Lentoramaria*.

Under the scanning electron microscope the spores of *R. corniculata* exhibit a slightly rough ornamentation, first observed by Pegler & Young (1985), who also pointed out the importance of good microscopic observations for this genus.

Specimens examined: GUERRERO: Mpio. of Taxco, Parque Cerro del Huizteco, Sept. 6, 1985, **Delgado y Pérez-Ramírez 569 (FCME 13515)**. **ESTADO DE MÉXICO:** Mpio. of Temascaltepec, km 54 Toluca-Temascaltepec highway, detour to El Polvorin, Sept. 24, 1988, **Villegas-Rios 1144 (FCME 14482)**.

Ramariopsis fusiformis (Sow.: Fr.) Petersen. 1978. **Mycologia 70:** 668.
≡ *Clavaria fusiformis* Sow.: Fr. 1821. **Syst. Mycol. 1:** 480.
≡*Clavulinopsis fusiformis* (Sow.: Fr.) Corner. 1950. **Ann. Bot. Mem. 1:** 367.

Pl. **1**, fig. **a**; Pl. **2**, fig. **f**.

Fruit bodies up to 100mm high and up to 15mm wide on middle side; simple clubs, occasionally forked at the apices; deeply flattened to fusiform, terete downward to the base; apices rounded to subrounded; bright yellow (Methuen 3A8) to deep yellow (Methuen 4A8), with shadows

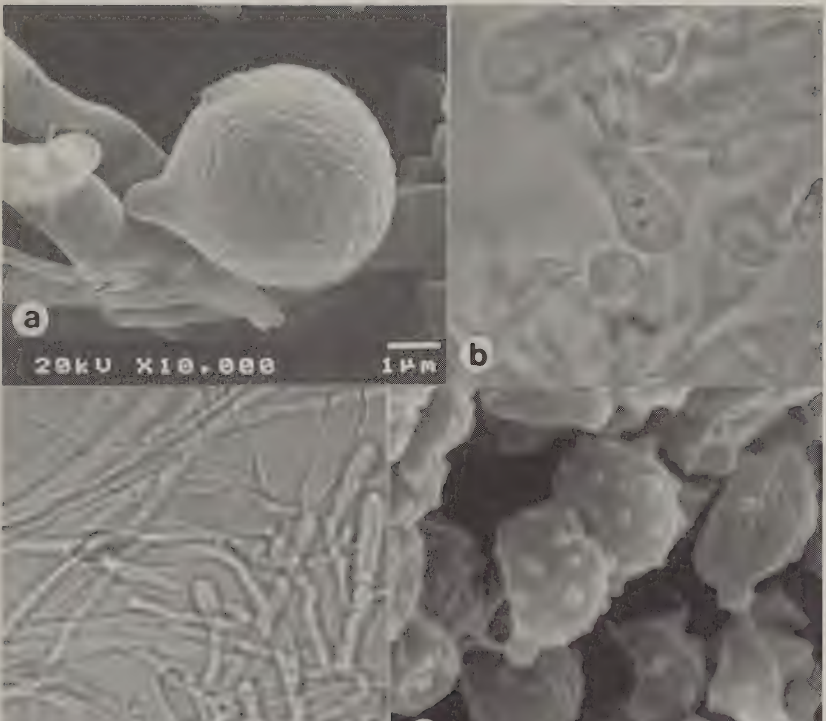

Plate 2: a) *Ramariopsis corniculata*, spores under SEM; **b)** *R. laeticolor* f. *bulbispora*, spores under FM; **c)** *R. laeticolor*, geniculated basidia under FM; **d)** *R. pulchella*, spores under SEM,; **e)** *R. laeticolor*, spores under FM; **f)** *R. fusiformis*, spores and hyphae under FM.

Abbreviations: FM, fotonic microscope; SEM, scanning electron microscope.

of orange colour or sunflower yellow (Methuen 4A7) on the middle side, apices, apricot yellow (Methuen 5B6); consistency fibrous on the center and slightly fleshy cartilagineous outward; context hollow at the level of hymenium and solid downward. Stipe slightly differentiated, terete to slightly flattened, sometimes whitish, glabrous. Odor and taste innapreciable.

Positive reaction to iron salts on hymenium, changing to greenish gray immediately or after 1 minute, even on dried samples.

Tramal hyphae monomitic, parallel, slightly agglutinated, clamped, some hyphae slightly inflated up to 7µm wide, sometimes with slightly thickened walls, some hyphae with yellowish content. Subhymenium with slender hyphae of yellowish content, loosely interwoven. Hymenium slightly thickened and agglutinated; basidia on simple clubs with slightly yellowish to bright golden colour content, four spored, with straight sterigmata.

Spores 4.9-9.1 x 4.9-9.1µm, globose, usually with yellow content and slightly thickened walls, usually uniguttulate, smooth; hilar appendix conical and prominent.

Fruit bodies fasciculate to slightly connate; terricolous. On pinus-oak forest.

Commentary

Only one of the examined specimens exhibited flattened fruit bodies, forked at the apex. This feature had been reported by Petersen (1968) as very unusual, a point which was confirmed by the examination of the Mexican samples.

This species is reported by Moreno-Fuentes (1994) in the Mexican Sate of Chihuahua, but a deeper examination of the specimen (**Moreno-Fuentes VI-5** [FCME 5665]) revealed differences with *R. fusiformis*, such as phaseoliphorm and multiguttulate spores with short hilar appendix and clampless contextual hypha, a combination of features which lead us to *Clavaria*.

Specimens examined: **HIDALGO**: Mpio. of Zacualtipan, km 100 Pachuca-Tampico highway, Oct. 2, 1989, **Villegas-Rios 1305 (FCME 2688)**; Pachuca-Tampico highway, 3 km from the detour to Tianguistengo, La Cantera, Sept. 30, 1989, **Villegas-Rios 1289 (FCME 2663)**. **TAMAULIPAS**: Mpio. of Gómez Farias **VERACRUZ**: Mpio. of Jalancingo, Ocotepec, **Ventura 5835**, Jul. 28, 1972, **(ENCB)**; Mpio. of Chiconquiaco, Guacamaya, **Ventura 7590**, Dec. 11, 1972, **(ENCB)**; Mpio. of Banderilla, Cerro La Martinica, **Santillán s/n**, Sept. 3, 1988, **(ENCB)**; Mpio. of Chiconquiaco, Río Resbaloso, **Ventura 13281**, Sept. 15, 1976, **(ENCB)**.

Ramariopsis laeticolor (B. & C.) Petersen. 1978. **Mycologia 70:** 668.
≡ *Clavaria laeticolor* Berkeley & Curtis. 1868. **Jour. Linn. Soc. Bot. 10:** 338.
≡ *Clavulinopsis laeticolor* (B. & C.) Petersen. 1965. **Mycologia 57:** 522.
= *Clavaria pulchra* Peck. 1876. **Rep. N.Y. State Mus. 28:** 53.
= *Clavulinopsis pulchra* (Pk.) Corner. 1950. **Ann. Bot. Mem. 1 :** 384.

Pl. **1**, fig. **b**; pl. **2**, fig. **c** y **e**.
Fruit bodies up to 40mm high and 1.5mm wide; simple clubs, terete to slightly flattened and then sulcate, apices rounded to slightly acute; growing from a small white micelial patch, of cottony appearance; bright yellow colour (Methuen 4A4) on the hymenium side, apices orange colour (Methuen 5A7) with yellow shadows; consistency fragile cartilagineous; hollow context at the hymenium level and solid downward to the base. Stipe slightly differentiated, terete, sometimes whitish. Odorless and tasteless.
Positive reaction to iron salts on dried samples, changing to grayish olive-green immediately.
Tramal hyphae monomitic, parallel, slightly agglutinated, clamped, some hyphae slightly inflated up to 6.3μm wide, sometimes with slightly thickened walls, some hyphae with yellowish content. Subhymenium with slender hyaline hyphae, loosely interwoven. Hymenium slightly thickened and agglutinated; basidia on simple clubs or geniculate, contents hyaline or bright golden colour, two or four spored, with straight or slightly sinuous sterigmata.
Spores 5.6-8.4 x 4.2-5.6μm, elongated to ovoid, hyaline or with yellowish contents, if guttulate then uniguttulate, smooth; hilar appendix conical and prominent.
Fruit bodies fasciculate to slightly connate, humicolous or terricolous. On rain forest or oak forest.

Commentary

This species has some outstanding features like the size of the fruit bodies and the shape of the spores. The fruit bodies usually grow from a small mycelial patch present on *R. laeticolor* f. *bulbispora* and *R. fusiformis* also. This latter species has been proposed as an allied taxon of this species (Petersen, 1988). Other similarities between these taxa are the hollow fruit bodies at the hymenium level. These features have not been analysed in a formal way to allow any probable phylogenetical implications to be discerned.

Specimens examined: **GUERRERO**: Mpio. of Taxco, Cerro de Huizteco Park, **Villegas-Rios 1803**, Aug. 30, 1995, (**FCME 6996**). **NAYARIT**:

Mpio of Tepic, La Noria in the Ecological Reservation Cerro de San Juan, **Villegas-Rios 1438**, Sept. 25, 1991, **(FCME 4095)**.

Ramariopsis laeticolor f. *bulbispora* (Petersen) Petersen. 1988. **The Clavarioid Fungi of New Zealand:** 129.
≡ *Clavulinopsis laeticolor* f. *bulbispora* Petersen. 1968. **Mycol. Mem. 2 :** 28.

Pl. **2**, fig. **b**.
Fruit bodies up to 70mm high and 2mm wide, simple clubs, terete to slightly flattened and then sulcate, apices rounded to slightly acute; sunflower yellow colour (Methuen 4A7) to reddish yellow (Methuen 4A8), apices sometimes dark brown; consistency fragile cartilagineous; hollow context at the hymenium level and solid downward to the base. Stipe clearly differentiated, up to 25mm high, terete to slightly flattened, bright yellow (Methuen 4A4), glabrous. Odorless and tasteless.
Positive reaction to $FeSO_4$ on hymenium of dried specimens, changing to greenish gray immediately.
Tramal hyphae monomitic, parallel, slightly agglutinated, clamped, some hyphae slightly inflated up to 7µm wide, sometimes with slightly thickened walls, hyaline. Subhymenium with narrow hyphae, loosely interwoven. Hymenium thickened, agglutinated; basidia on simple clubs, sometimes with yellow contents, two, three, and four spored, with slightly sinuous sterigmata.
Spores 4.2-7.0 x 4.2-4.9µm, bulbose, with abaxial broadening, sometimes subglobose to ovoid; commonly with yellow contents, thickened walls, if guttulate then uniguttulate, smooth; hilar appendix conical, prominent, and lateral.
Fruit bodies gregarious, terricolous. On rain forest or oak forest.

Commentary.
This form constantly and typically shows spores with a prominent abaxial broadening, as has already been ascertained in previous reports (Petersen, 1968, 1988). This species exhibit a hollow context at the hymenium level, like *R. laeticolor*.
One of the examined specimens (**Altamirano 628**, TLXM), labeled as *R. laeticolor*, shows colors and spores like *R. laeticolor* f. *bulbispora*, but differs in the absence of a well differentiated stipe and caespitous fruit bodies of smaller size. These obvious differences lead us to exclude this specimen for the present description.

Specimens examined: **Michoacán**: Mpio. of Nahuatren, Cerro el Pilón, **Hernández 188**, Aug. 19, 1995, **(IBUG)**. **Nayarit**: Mpio. of Tepic, La Capilla in the Ecological Reservation of Cerro de San Juan, **Villegas-Rios 1450**, Sept. 26, 1991, **(FCME) 4339**.

Ramariopsis pulchella (Boud.) Corner. 1950. **Ann. Bot. Mem. 1**: 645.
≡ *Clavaria pulchella* Bourdier. 1887. **Bull. Soc. Mycol. France 3**: 146.
≡*Clavulinopsis pulchella* (Boud.) Jülich. 1985. **Int. J. Mycol. Lichenol. 2**: 120.

Pl. **1**, fig. **d**; pl. **2**, fig. **d**.
Fruit bodies up to 35mm high, well branched on three levels, branches usually dichotomous, rarely trichotomous, axils rounded, white downward to the base and indigo blue upward to the tips (Methuen 18B3, 18C3); consistency fibrous fleshy, strigose, or subleathery; solid context. Stipe slightly to well differentiated, but always present, white with grayish orange colour shadows (Methuen 5D3) at maturation, flattened. Branches terete to slightly flattened, narrowing to the tips; whitish to violaceous (Methuen 18B3), purple (Methuen 14C2), or violet (Methuen 17B2); apices subrounded to subacute, concolorus to brownish.
Negative reaction to $FeSO_4$ on hymenium.
Tramal hyphae monomitic, parallel, slightly agglutinated, clamped, some hyphae with slightly thickened walls and yellow contents usually closer to stipe base, some inflated hyphae up to 8µm wide. Hymenium thickened, agglutinated; basidia simple club, slightly violaceous, four spored, with straight sterigmata, small crystals common on hymenium.
Spores 2.8-4.2 x 2.1-3.5µm, subglobose, hyaline, with thick walls, uniguttulate, spiny, hilar appendix conical, prominent.
Fruit bodies gregarious to slightly fasciculated, terricolous. On *Juniperus* forest.

Commentary

This species typically shows fruit bodies with violet colors and small subglobose spores. The presence of thick walled hyphae with yellow content and positive reaction to KOH 2% on hypae of dried specimens, changing to pink and then to olive green, like some violet colored species of *Ramaria* and *Gomphus* lead Petersen (1988) to postulate links between *Ramariopsis* and Gomphaceae.

Specimens examined: TLAXCALA: Mpio. of Ixtacuixtla, Km. 10.5 of the Texmelucan-Tlaxcala highway, **Altamirano 149** & **157**, Sept. 8, 1994 (**TLXM**).

DISCUSSION

The present is the first taxonomical review of the genus *Ramariopsis* in Mexico. It yielded four species, new records of them and one form new record for Mexico, on pinus-oak, rain forest and *Juniperus* forest.

Traditionally, clavarioid fungi systematics has been a complex matter because these fungi are not a natural group. In the particular case of the genus *Ramariopsis*, the situation seems to be similar. This genus was first recognized by Corner (1950) who included in this group those species, previously assigned to *Clavaria*, that showed branched fruit bodies, tramal hyphae monomitic and clamped, and spiny spores. Corner suggested that due to the contextual construction and spore ornamentation *Clavulinopsis* and *Scytinopogon* are closely allied genera of *Ramariopsis*. Afterwards Petersen (1966), considering some features like hysterocroism and the size of the basidia, proposed an emendation of the genus. He thus tranferred some species -like *R. corniculata*, previously as *Clavulinopsis*- of bright colored fruit bodies and globose, smooth spores to *Ramariopsis*. Corner (1970) subsequently argued that hysterocroism and basidia size overlap between both genera and are not good features. Petersen (1978) responded by using pigment composition, cytological features, like the number of remaining nuclei in the basidia, and phenolic compounds in the hymenium to support a new emendation of the genus, transferring some species of *Clavulinopsis* to *Ramariopsis* and the rest to *Clavaria*.

At the present no consensus exists regarding the delimitation of the genus or diagnostic features. Several contributions have been made (Jülich, 1985; Pegler & Young, 1985) in the attempt to solve this dispute, though none has presented enough reasons to favor any position.

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MYXOMYCETES OF THE STATE OF BAHIA, BRAZIL: HISTORICAL REVIEW AND CURRENT SITUATION

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ABSTRACT

A critical analysis of myxomycete diversity was carried out for the State of Bahia, Brazil including a historical review and field surveys. A total of 63 taxa have been recorded between 1913 and 2000, belonging to the orders (a) Ceratiomyxales (*Ceratiomyxa*, 1 sp.), (b) Liceales (*Cribraria*, 3 spp.; *Dictydium*, 1 sp.; *Enteridium*, 1 sp.; *Lycogala*, 2 spp.; *Tubifera*, 1 sp.), (c) Trichiales (*Arcyria*, 8 spp.; *Hemitrichia*, 3 spp.; *Metatrichia*, 1 sp.; *Perichaena*, 3 spp.; *Trichia*, 1 sp.); (d) Physarales (*Craterium*, 1 sp.; *Diachea*, 1 sp.; *Diderma*, 3 spp.; *Didymium*, 7 spp., *Fuligo*, 1 sp.; *Physarum*, 19 spp.; *Physarella*, 1 sp.) (e) Stemonitales (*Comatricha*, 2 spp.; *Stemonitis*, 3 spp.). Most taxa were collected and studied by Father Camille Torrend between 1913 and 1916.

Key words: Myxomycota, diversity, neotropical region.

INTRODUCTION

The myxomycetes are a group of organisms of ambiguous systematic position and considerable evolutionary interest. Originally, they were considered as part of Fungi since historically they have been studied much more frequently by botanists and/or mycologists. However, they are currently classified as a single class *Myxomycetes* of the phylum *Myxomycota* in the protistan universe (Alexopoulos et al., 1996). In a phylogenetic analysis of eukaryotes based on a large small subunit rDNA data set, the slime mold representative, *Physarum polycephalum* Schw., made up the sister group to all other eukaryotes except the Microsporidia, Parabasiida, Diplomonadia, Euglenida and Kinetoplastida (Lipscomb et al., 1998). Although myxomycetes are not true fungi (chitinous fungi or Eumycota), their taxonomy continue to be studied practically only by mycologists.

The state of knowledge of myxomycetes in Brazil is mainly restricted to specialists' study areas (Putzke, 1996; Bicudo & Menezes, 1996). Most of known myxomycete diversity in the State of Bahia is from the studies of Father Camille Torrend (1914, 1915, 1916), Gottsberger (1968) and Góes-Neto (1994, 1996).

The present work is intended to: (a) diagnose the myxomycetan biodiversity via an historical review, (b) present the results of recent surveys and (c) analyze the current state of knowledge of myxomycete diversity in the State of Bahia, Brazil.

MATERIAL AND METHODS

This paper is a result of three distinct goals: (1) Historical Review, (2) Recent Taxonomic Surveys and (3) Current Situation. The first goal consists in a bibliographic review of myxomycetes recorded for the State of Bahia. In this part of the work the access to Torrend's personal manuscripts was paramount. The second goal is the results of preliminary taxonomic surveys of myxomycetes in four distinct municipalities_in Bahia. The third goal is a critical analysis of the current state of knowledge of the diversity of myxomycetes in the State of Bahia.

RESULTS AND DISCUSSION

1. Historical Review

There is no record in the literature about collections of myxomycetes in Bahia before 1913 (Góes-Neto, 1994). In the following year Torrend (1914) published his third checklist of fungi from Portugal, Brazil and Portuguese colonies with a citation of three species of myxomycetes collected in the State of Bahia. These collections were made by some of his colleagues, Jesuits, who were living in Bahia by that time in two different localities – one in a tropical rain forest region (municipality of Salvador) and another in a Caatinga region (municipality of Caitité).

One year after his arrival in Brazil, Torrend (1915) published the most complete review about myxomycetes of the whole country, recording 40 species that were undoubtedly collected in the State of Bahia. Although the author frequently pointed out the precise location of collections, which were mainly in the municipalities of Salvador, Cachoeira, Salinas da Margarida, Itaparica and Caitité, many of them were simply indicated to Bahia as a whole.

One year later Torrend (1916) presented a work in the 5th Brazilian Congress of Geography, in which he recorded a total of 58 myxomycete species for the State of Bahia, including 18 taxa that had not been cited in his previous paper in the year before. The results of this presentation were published as an article in the annals of this congress. This article apparently seems to have been ignored by all further myxomycetologists, who dedicate themselves to the study of Brazilian myxomycetes, since it has not been cited in any article that treated these organisms after 1916. The rediscovery of this paper is extremely important, for it revealed not only 18 taxa that have not been cited before, but it also contained the diagnosis of a presumptive new species, *Hemitrichia insignis* n.sp.

After a period of more than 50 years without any publication on Bahian myxomycetes, Farr (1960), reviewing the myxomycetes kept at URM, found a collection of 14 species, which had been collected and identified by Torrend. Although there was no information about where those specimens had been collected, and as she ignored the existence of Torrend's article mentioned before, it was impossible for her determining collection localities. Analysing Torrend´s last paper on myxomycetes, we realised that the collection numbers of recorded species in this paper exactly matched with the collection numbers of URM specimens labels. Thus it could be inferred that these specimens constitute what remained of Torrend's collection.

In her paper Farr (1960) did not cite the specimen that might be the new taxon (*Hemitrichia insignis* n.sp.) among Trichiaceae. Recently, revising Torrend's collection, however, we found a Trichiaceae specimen (URM 574a) that probably corresponds to this new taxon since the collection number on the herbarium label and the number indicated in Torrend's paper (1916) are the same. Unfortunately, the material is in too poor conditions to be studied.

Gottsberger (1968) carried out a taxonomic survey of myxomycetes collected during an expedition that crossed the States of Bahia and Goiás in Brazil in late 1960's. In the State of Bahia, he collected material in seven municipalities which are situated in two distinct phytogeographic regions: Caatinga and Cerrado. The author described a total of 13 species, including 4 new citations for the State of Bahia and a new species, *Didymium bahiense* Gottsberger.

The following table (Table I) contains all myxomycete species, in alphabetical order, recorded for the State of Bahia. It also indicates about the localities where they were collected, bibliographic reference, and original citation. The disposition of the names follows Martin, Alexopoulos & Farr (1983).

Table I Myxomycetes recorded in literature for Bahia, Brazil

TAXON	LOCALITY	REFERENCE	ORIGINAL CITATION
1. *Arcyria cinerea* (Bull.) Pers.	Not indicated	Torrend, 1915 Torrend, 1916	*Arcyria digitata* Rostaf.
2. *Arcyria denudata* (L.) Wettst.	Not indicated	Torrend, 1915 Torrend, 1916	
3. *Arcyria globosa* Schwein.	Cachoeira	Torrend, 1915 Torrend, 1916	
4. *Arcyria incarnata* (Pers.) Pers.	Not indicated	Torrend, 1916	
5. *Arcyria oerstedii* Rostaf.	Itaparica	Torrend, 1915 Torrend, 1916	
6. *Arcyria pomiformis* (Leers) Rostaf.	Not indicated	Torrend, 1915 Torrend, 1916	
7. *Arcyria versicolor* W.Phillips	Cachoeira	Torrend, 1915 Torrend, 1916	
8. *Ceratiomyxa fruticulosa* (O.F.Müll) T.Macbr.	Salvador (1,2,3), Caetité (1,2,3), Correntina (4), Morro do Chapéu (4)	Torrend, 1914 (1*) Torrend, 1915 (2) Torrend, 1916 (3*) Gottsberger, 1968 (4)	*Ceratiomyxa arbuscula* Berk. (1*, 3*) *Ceratiomyxa porioides* Schreet. (1*, 3*)
9. *Comatricha longa* Peck	Not indicated	Torrend, 1916	
10. *Craterium leucocephalum* (Pers.) Ditmar	Cachoeira	Torrend, 1915 Torrend, 1916	
11. *Cribraria argillacea* Pers.	Salinas da Margarida	Torrend, 1916	
12. *Cribraria intricata* Schrad.	Not indicated	Torrend, 1916	*Cribraria dictydioides* Cook & Balf. f. ex Massee
13. *Diachea leucopodia* (Bull.) Rostaf.	Not indicated	Torrend, 1915 Torrend, 1916	
14. *Dictydium cancellatum* (Batsch) T.Macbr.	Not indicated	Torrend, 1916	

Table I Myxomycetes recorded in literature for Bahia, Brazil (cont.)

TAXON	LOCALITY	REFERENCE	ORIGINAL CITATION
15. *Diderma hemisphericum* (Bull.) Hornem.	Not indicated	Torrend, 1915 Torrend, 1916	
16. *Diderma spumarioides* (Fr.) Fr.	Not indicated	Torrend, 1915	
17. *Diderma testaceum* Pers.	Not indicated	Torrend, 1916	
18. *Didymium bahiense* Gottsb.	Morro do Chapéu	Gottsberger, 1968	
19. *Didymium clavus* (Alb. & Schwein.) Rabenh.	Cachoeira	Torrend, 1915 Torrend, 1916	
20. *Didymium difforme* (Pers.) Gray	Morro do Chapéu	Gottsberger, 1968	
21. *Didymium iridis* (Ditmar) Fr.	Not indicated	Torrend, 1915 Torrend, 1916	*Didymium xanthopus* Lister
22. *Didymium melanospermum* (Pers.) Macbr.	Salvador	Torrend, 1915 Torrend, 1916	*Didymium eximium* Peck
23. *Didymium minus* (Lister) Morgan	Morro do Chapéu	Gottsberger, 1968	
24. *Didymium squamulosum* (Alb. & Schwein.) Fr.	Salvador	Torrend, 1915 Torrend, 1916	
25. *Enteridium lycoperdon* (Bull.) M.L.Farr	Not indicated	Torrend, 1916	
26. *Fuligo septica* (L.) Wiggers)	Not indicated	Torrend, 1915 Torrend, 1916	
27. *Hemitrichia calyculata* (Speg.) M.L.Farr	Not indicated (1), Correntina (2)	Torrend, 1915 (1) Torrend, 1916 (1), Gottsberger, 1968 (2)	*Hemitrichia clavata* (Pers.) Rostaf. (1), *Hemitrichia stipitata* (Massee) T.Macbr. (2)
28. *Hemitrichia insignis* Torrend	Poções	Torrend, 1916	
29. *Hemitrichia serpula* (Scop.) Rostaf.	Not indicated	Torrend, 1915 Torrend, 1916	
30. *Lycogala conicum* Pers.	Not indicated	Torrend, 1916	
31. *Lycogala epidendrum* (L.) Fr.	Not indicated (1), Correntina (2)	Torrend, 1916 (1) Gottsberger, 1968 (2)	
32. *Metatrichia vesparium* (Batsch) Nann.-Bremek.	Not indicated	Torrend, 1916	*Hemitrichia vesparium* (Batsch) T.Macbr.
33. *Perichaena chrysosperma* (Currey) Lister	Salvador	Torrend, 1915 Torrend, 1916	*Perichaena chrysospora* Lister
34. *Perichaena depressa* Lib.	Not indicated (1), Correntina (2)	Torrend, 1915 (1) Torrend, 1916 (1) Gottsberger, 1968 (2)	
35. *Perichaena microspora* Penz. & Lister	Cachoeira	Torrend, 1915 Torrend, 1916	

Table I Myxomycetes recorded in literature for Bahia, Brazil (cont.)

TAXON	LOCALITY	REFERENCE	ORIGINAL CITATION
36. *Physarella oblonga* (Berk. & M.A.Curt.) Morgan	Not indicated	Torrend, 1915 Torrend, 1916	
37. *Physarum bethelii* T.Macbr. ex Lister	Salvador	Torrend, 1915 Torrend, 1916	
38. *Physarum bivalve* Pers.	Salvador	Torrend, 1915 Torrend, 1916	*Physarum sinuosum* Rostaf.
39. *Physarum bogoriense* Racib.	Not indicated (1), Morro do Chapéu (2)	Torrend, 1916 (1), Gottsberger, 1968 (2)	
40. *Physarum cinereum* (Batsch) Pers.	Not indicated, (1) Morro do Chapéu (2)	Torrend, 1915 (1) Torrend, 1916(1) Gottsberger, 1968 (2)	
41. *Physarum compressum* Alb. & Schwein.	Not indicated	Torrend, 1915	
42. *Physarum didermoides* (Pers.) Rostaf.	Itaparica	Torrend, 1915 Torrend, 1916	
43. *Physarum flavicomum* Berk.	Not indicated (1), Correntina (2)	Torrend, 1916 (1) Gottsberger, 1968 (2)	
44. *Physarum gyrosum* Rostaf.	Not indicated	Torrend, 1916	
45. *Physarum javanicum* Racib.	Santa Maria da Vitória	Gottsberger, 1968	
46. *Physarum melleum* (Berk. & Broome) Massee	Salvador	Torrend, 1915 Torrend, 1916	
47. *Physarum nutans* Pers.	Not indicated	Torrend, 1915 Torrend, 1916	
48. *Physarum pezizoideum* (Jungh.) Pavillard & Legarde.	Not indicated	Torrend, 1916	*Trichamphora pezizoidea* Jungh.
49. *Physarum polycephalum* Schwein.	Salinas da Margarida (1), Morro do Chapéu (2)	Torrend, 1915 (1); Torrend, 1916 (1), Gottsberger, 1968 (2)	
50. *Physarum pusillum* (Berk. & M.A.Curt.) G. Lister	Salvador (1), Morro do Chapéu (2)	Torrend, 1915 (1) Torrend, 1916 (1) Gottsberger, 1968 (2)	
51. *Physarum stellatum* (Massee) G.W.Martin	Cachoeira	Torrend, 1915 Torrend, 1916	*Physarum compactum* Lister
52. *Physarum tenerum* Rex	Cachoeira	Torrend, 1915	
53. *Physarum vernum* Sommerf.	Not indicated	Torrend, 1915 Torrend, 1916	
54. *Physarum virescens* Ditmar	Salvador	Torrend, 1915 Torrend, 1916	
55. *Physarum viride* (Bull.) Pers.	Not indicated	Torrend, 1916	
56. *Stemonitis axifera* (Bull.) T.Macbr.	Not indicated	Torrend, 1916	*Stemonitis ferruginea* Ehrenb.
57. *Stemonitis fusca* Roth	Salvador (1), Caetité (2)	Torrend, 1914 (1) Torrend, 1915 (2) Torrend, 1916 (2)	

Table I Myxomycetes recorded in literature for Bahia, Brazil (cont.)

TAXON	LOCALITY	REFERENCE	ORIGINAL CITATION
58. *Stemonitis splendens* Rostaf.	Salvador	Torrend, 1915 Torrend, 1916	
59. *Trichia favoginea* (Batsch) Pers.	Cachoeira	Torrend, 1915 Torrend, 1916	*Trichia persimilis* Karst.
60. *Tubifera microsperma* (Berk. & M.A.Curt.) G.W.Martin	Not indicated	Torrend, 1916	*Tubifera stipitata* T.Macbr.

Nevertheless the records are restricted to only 9 municipalities, the main vegetation types in the State of Bahia are all represented in this sample: Atlantic Forest (Salvador, Itaparica, Salinas da Margarida), Seasonal Forest (Cachoeira), Caatinga (Caetité, Morro do Chapéu, Poções), and Cerrado (Correntina, Santa Maria da Vitória).

2. Recent Surveys in the State of Bahia

Since 1968 no survey of myxomycete biota in Bahia has been reported. By the present work it is intended to reinitiate the inventory of Bahian myxomycetes. New surveys were carried out in the municipalities of Salvador (12°58' S, 38°17' W), Santa Terezinha (Serra da Jibóia, 12°46° S, 39°41' W), Una (Biological Reserve of Una, 15°06'-15°12' S lat.; 39°02'-39°12' W long.) and Uruçuca (14°35' S, 39° 17'). In all but one of these municipalities the main vegetation type is the Atlantic Forest (tropical rain forest). Although the Caatinga represents the main vegetation type in Santa Terezinha, the specimens were collected in an Atlantic Forest fragment in a mountainous region (Serra da Jibóia, 750-800m) in this municipality.

Fifteen taxa were recorded including representatives of the Ceratiomyxales, Liceales, Trichiales, Physarales and Stemonitales. Three of them are new citations for the State of Bahia: *Arcyria insignis*, *Comatricha pulchella* and *Cribraria* cf. *microcarpa*. Table II lists all the species recorded in these recent surveys, including voucher numbers, and localities where they were collected.

Table II Recent records of myxomycetes in the State of Bahia, Brazil (new citations for the State of Bahia are in bold)

TAXON	LOCALITY	VOUCHER
1. *Arcyria cinerea* (Bull.) Pers.	Ilhéus, Una, Salvador	Messias & Oliveira, 29 Góes-Neto, 37, 127;
2. *Arcyria denudata* (L.) Wettst.	Una, Salvador*, Santa Terezinha	Góes-Neto, 27, 133*, 134* Cavalcanti, 602
3. *Arcyria insignis* Kalchbr. & Cooke	**Santa Terezinha, Salvador**	**Góes-Neto, 132, 141**
4. *Ceratiomyxa fruticulosa* (O.F.Müll) T.Macbr.	Ilhéus	Góes-Neto, 171
5. *Comatricha pulchella* (C. Bab.) Rostaf.	**Salvador**	**Góes-Neto, 144**
6. *Cribraria* cf. *microcarpa* (Schrad) Pers.	**Santa Terezinha**	**Cavalcanti, 604**
7. *Fuligo septica* (L.) Wiggers)	Salvador	Góes-Neto, 161, 190
8. *Hemitrichia calyculata* (Speg.) M.L.Farr	Ilhéus	Góes-Neto, 172

Table II Recent records of myxomycetes in the State of Bahia, Brazil (new citations for the State of Bahia are in bold)

TAXON	LOCALITY	VOUCHER
9. *Perichaena chrysosperma* (Currey) A.Lister	Santa Terezinha	Cavalcanti, 603
10. *Perichaena depressa* Lib.	Una, Uruçuca	Góes-Neto, 77, 152
11. *Physarum compressum* Alb. & Schwein.	Ilhéus	Messias & Oliveira, 31
12. *Physarum nutans* Pers.	Salvador	Góes-Neto, 128, 143
13. *Physarum polycephalum* Schwein.	Salvador	Góes-Neto, 130, 140
14. *Stemonitis fusca* Roth	Salvador, Uruçuca	Góes-Neto, 129, 149
15. *Tubifera microsperma* (Berk. & M.A.Curt.) G.W.Martin	Una	Góes-Neto, 26

3. Current Situation

After our survey a total of 63 taxa of myxomycetes are cited for the State of Bahia. The recorded taxa are distributed among the orders (a) Ceratiomyxales (*Ceratiomyxa*, 1 sp.), (b) Liceales (*Cribraria*, 3 spp.; *Dictydium*, 1 sp.; *Enteridium*, 1 sp.; *Lycogala*, 2 spp.; *Tubifera*, 1 sp.), (c) Trichiales (*Arcyria*, 8 species; *Hemitrichia*, 3 spp.; *Metatrichia*, 1 sp.; *Perichaena*, 3 spp.; *Trichia*, 1 sp.); (d) Physarales (*Craterium*, 1 sp.; *Diachea*, 1 sp.; *Diderma*, 3 spp.; *Didymium*, 7 spp., *Fuligo*, 1 sp.; *Physarum*, 19 spp.; *Physarella*, 1 sp.) (e) Stemonitales (*Comatricha*, 2 spp.; *Stemonitis*, 3 spp.).

Some of the myxomycetes collected in Bahia between 1913 and 1968 are deposited in URM (Recife, State of Pernambuco, Brazil – Federal University of Pernambuco) and SP (São Paulo, State of São Paulo, Brazil – Institute of Botany). Recent collections are in ALCB (Salvador, State of Bahia, Brazil – Federal University of Bahia) and UFP (Recife, State of Pernambuco, Brazil – Federal University of Pernambuco).

Cavalcanti (1996a) recorded a total of 214 species of Myxomycetes for Brazil, including representatives of all orders and families currently accepted, with the exception of Schenellaceae (Stemonitales). Presently, the known myxomycetes from Bahia (6.6% of the area of Brazil) make up as much as 29.4% of species known for whole Brazil. Furthermore, the myxomycete biota of Bahia is also considerably diversified in comparison of what is known for Brazilian states in the North (Cavalcanti et al, 1999), Northeast (Cavalcanti, 1996b; Mobin & Cavalcanti, 1998, 1999 a, 1999b, 2000), Southeast (Hochgesand & Gottsberger, 1996) and South (Rodrigues, 1990; Gottsberger et al 1992; Cavalcanti & Fortes, 1995).

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BIOSYSTEMATICS OF THE MYXOMYCETE ARCYRIA CINEREA

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Abstract: Seven isolates of the small brownish ochraceous form and six isolates of the small long-stalked pallid form of the myxomycete *Arcyria cinerea* were cultured from spore to spore on agar. Three of the small pallid isolates from Ecuador were heterothallic and belonged to two sympatric biological sibling species: A1 containing the Ecu 3 isolate and A2 containing the Ecu 1 and Ecu 2 isolates. The other ten isolates were nonheterothallic. Plasmodial fusion studies also indicated that these ten nonheterothallic isolates were divided into nine genetically different clonal lines that also did not fuse with any of the three heterothallic isolates. Morphological examination of these isolates indicated that several of the small brownish ochraceous isolates matched the description of *Arcyria pomiformis* with the exception that they lacked papillae on the inner calyculus. Since, in this study, the brownish ochraceous form of *A. cinerea* appears to be as close to *A. pomiformis* as it is to the grey form of *A. cinerea*, further studies including more isolates are needed to unravel this morphological complex.

Key Words: *Arcyria pomiformis*, myxomycetes, nonheterothallism

INTRODUCTION

While the laboratory cultivation of myxomycetes goes back to deBary (1887) and Lister (1901), most of the cultured species, to date, have been in the order Physarales, with only eight examples reported in the order Trichiales: three species of *Arcyria*, one of *Metatrichia*, three of *Perichaena*, and one of *Trichia* (Clark 1995). Even less is known about reproductive systems, with two reported nonheterothallic isolates of *Perichaena* the only known examples of this condition known for the entire order (Clark 1995). As such, there is a need for further studies of species in this order to develop a better understanding of the range of morphological variations possible and also to determine the reproductive systems present in a particular morphospecies. This information could lead to a more natural delimitation of species in a group in which the typological species concept is presently prevalent. Alexopoulos (1960) published the first report on spore to spore cultivation of *Arcyria cinerea* (Bull.) Pers. and while, it has been used in a number of developmental studies (Mims 1969), no mating system information has been reported, to date, for this species or any other member of the genus. This paper reports the cultivation of thirteen isolates of *A. cinerea* and provides information on their morphological variations, plasmodial fusion, and reproductive system.

MATERIALS AND METHODS

Spores from sporangia, derived from either field collections or obtained from moist chamber cultures, were plated on ½ CM agar (8 g Difco corn meal agar and 8 g plain agar per L of distilled water), where they germinated to produce amoebal populations and eventually plasmodia. These plasmodia were then cleaned of all fungal and most bacterial contamination by allowing them to migrate over 2% water agar (20 g plain agar per L of distilled water). The purified plasmodia, after being fed with sterile rolled oats and covered with a thin water film, grew into large plasmodia that were induced to sporulate by placing them in a lighted chamber on 4% water agar. Starting with a set of approximately 55 field collections, thirteen viable cultures were established that could be grown from spore to spore on agar (TABLE I). The sporangia produced by these 13 isolates were then used as a source of spores to test for reproductive systems. Single spore derived myxamoebal clones were isolated by dilution spotting (a spore suspension was spotted on ½ CM plates at a dilution which insured that any growth was derived from a single spore). If the resulting amoebal clones produced plasmodia by themselves, they were classified as nonheterothallics. However, if they did not form plasmodia unless they were crossed against clones carrying different mating types, they were considered heterothallic. In either case, some of the resulting plasmodia were allowed to sporulate and the reproductive system was tested in a second generation. A minimum of 20 clones for each generation was tested per isolate.

TABLE I. Isolates and their origin

Isolate	Derivation[a]
Ochraceous forms:	
CR 2[b]	Clark, banana leaf litter, plantation near Cahuita
CR 3	Clark, banana leaf litter, farm near Cahuita
CR 4	Clark, banana leaf litter, plantation near San Jose
CR 5	Clark, banana leaf litter, OTS field station at La Selva
CR 6	Landolt, soil culture from Costa Rica
CR 7	Clark, *Heliconia* litter, Monteverde Cloud Forest Reserve
CR 8	Clark, *Heliconia* litter, Monteverde Cloud Forest Reserve
Small pallid long-stalked forms:	
CR 1	Stephenson 8192B, forest floor leafy litter near Cahuita
Ecu 1	Schnittler 17589, aerial leafy litter, Yasuni Reserve
Ecu 2	Schnittler 17787, forest floor leafy litter, Yasuni Reserve
Ecu 3	Schnittler 17806, aerial leafy litter, Yasuni Reserve
Ecu 4	Schnittler 17863, folicolous liverworts on living leaves, Yasuni Reserve
Mex 1	Schnittler 16291, *Heliconia* aerial litter, El Eden, Qunitana Roó

[a] All isolates are derived from moist chamber cultures.

[b] Indicates country of origin: CR = Costa Rica, Ecu = Ecuador, Mex = Mexico.

RESULTS

Ten of the isolates produced plasmodia without crossing in both generations of amoebal clones and, therefore, these ten isolates were nonheterothallic. The Ecu 1, Ecu 2, and Ecu 3 isolates did not produce plasmodia without crossing and were, therefore, presumably heterothallic. The clones of the Ecu 3 isolate displayed two mating types: $A1^1$ and $A1^2$ in a normal 1:1 ratio. However, the Ecu 1 and Ecu 2 isolates did not produce plasmodia when crossed amongst themselves (within each isolate) or with either of the two Ecu 3 mating types, but they did produce plasmodia when clones were crossed between the two isolates (in any pairwise combination). Thus, the Ecu 1 and Ecu 2 isolates represent a different biological species than the Ecu 3 isolate, and they also segregate out only a single mating type from their sporangia: $A2^1$ in Ecu1 and $A2^2$ in Ecu 2. Second generation sporangia derived from crosses involving clones from the Ecu 1 and Ecu 2 isolates also displayed this skewed segregation pattern.

Plasmodial fusion tests were conducted between the original plasmodia of the thirteen isolates by cutting out two cm^2 blocks of agar from two different cultures and placing them on a new plate, where they migrated off the blocks and came into contact with each other. The contact zone was then scored for fusion or non-fusion. Since plasmodia have a complex genetic system (Ling and Clark 1981) that only allows fusion between identical or nearly identical plasmodia, a successful fusion is an excellent indicator of a close relationship between the two plasmodia. When the thirteen original plasmodia were tested in all possible pair-wise combinations, only one fusion occurred. This fusion was between the CR 7 and CR 8 plasmodia, which were both isolated from the same bulk *Heliconia* leaf litter sample and are thus probably members of a single clonal population.

While many of the isolates produced sparse and aberrant sporangia in culture, there were enough well-formed sporangia for microscopic observations of morphological features. These observations were recorded and used to compare the morphology of the isolates. All isolates could be accommodated within the Martin and Alexopoulos (1969) description parameters for the species. Seven of them were members of the small brownish ochraceous form most often found in moist chamber cultures. This form seems to prefer a basic pH litter, as provided by species of *Heliconia* or *Musa*. The sporothecae ranged from 0.1-0.6 mm in diameter and 0.4-1.5 mm in length and were sub-cylindrical to globose, with some taller (2.0 mm) heads found in the CR 6 isolate. This compares with the 0.1-0.2 x 0.2-0.4 mm ovate sporothecae of the small pallid form isolates, for which a detailed taxonomic description is given by Schnittler (2001). The latter form is found commonly in moist chamber cultures and also in the field, on aerial litter (dead but still attached plant parts such a palm fronds), folicolous liverworts, and more rarely on forest floor litter. The stalks, which are filled with spore-like cysts and are often clustered (a condition not found in the pallid form isolates), ranged from 0.2-0.6 mm in length in the ochraceous isolates, with a few sessile sporangia in CR 2. In comparison, the long stalked small pallid forms had stalks 0.8-1.2 mm in length. The sporangia have a small calyculus to which the network of brownish ochraceous (whitish in the pallid isolates), 2-3 μm diameter, spiny strands of the capillitium are tightly attached, with the CR 3, CR 7 and CR 8 isolates having denser, larger, and more blunt spines. The spores are smooth, colorless (pallid isolates) to slightly ochraceous (by transmitted light), and 6.5-7.5 μm in diameter. The brownish ochraceous isolates differ from the more standard grey form (which is common on wood) not only in color but also in sporotheca and stalk size (the grey form is usually larger, more cylindrical and often has a longer stalk), but conform in almost all other characteristics. The CR3, CR 7, and CR 8 isolates, with their capillitium having free blunt ends and heavy ornamentation, approach *Arcyria pomiformis* (Leers) Rost. As the latter is described in published descriptions; however, they lack the prominent inner calyculus papillae which Farr (1962) and Härkönen (1977) considered diagnostic.

DISCUSSION

While Martin and Alexopoulos (1969) indicate that intermediates between the grey and brownish ochraceous forms of *Arcyria cinerea* can be found in the same moist chamber culture, no grey forms were found mixed with ochraceous forms in the material examined in the present study. Also, while there was some variations in shape for the ochraceous form, the two forms were stable over a number of generations in culture. These results (three heterothallic isolates divided into two sympatric biological sibling species and ten nonheterothallic isolates with only a single plasmodial fusion between them) indicate that the taxon recognized as *A. cinerea* probably consists of a large number of genetically different clonal lines, which are most likely derived from a relatively few sexual isolates by means of meiotic suppression (Clark 1995, Clark and Haskins 1998). Also, since these independent clonal lines are free to adapt to local conditions and microenvironments, the production of a swarm of variable and overlapping phenotypes may occur. This could help explain the considerable variability found in *Arcyria cinerea*. The small pallid form is generally found on aerial litter and may be an ecotype adapted to this microhabitat. However, the fact that seven of the thirteen cultured isolates were of the small brownish ochraceous form (and the other six were of the small long stalked pallid form) may indicate that there is a break in the continuum between the grey and ochraceous forms. Whether this separation, and the one between the brownish ochraceous form and *A. pomiformis*, is at the species or infraspecific level will require further studies involving more isolates.

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NOTES ON TWO VIOLET SPECIES BELONGING TO PHYSARALES (MYXOMYCETES)

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Abstract: Basing on a macro- and microscopic study of type material, three species of the genus Physarales with violet sporocarps are compared: *Craterium paraguayense*, *C. rubescens* and *Physarum newtonii*. The synonymy of *C. rubescens* and *C. paraguayense* is confirmed, which have proved to be different from *P. newtonii*. SEM micrographs of the spore ornamentations are included.

Key words: *Craterium paraguayense*, *Craterium rubescens*, Myxomycota, *Physarum newtonii*, Spanish mycota, taxonomy

INTRODUCTION

In the course of various mycological campaigns carried out in the provinces of Barcelona and Girona (Catalonia, Spain), several specimens of Myxomycetes have been collected which were determined as *Physarum* cf. *newtonii* T. Macbr. This species was described from the American continent and there are only a few records from Spain and Europe. We therefore decided to compare the Spanish specimens with material from BPI, determined by Macbride, including the type collection.

LISTER (1894, 1911, 1925) indicated the resemblance of *Physarum newtonii* with *Craterium paraguayense* (Speg.) Lister "in colour, in the character of the capillitium, and in the structure of the sporangium wall", differing "in the shape of the sporangia and the dark rough spores". The habitats of *Physarum newtonii* and *C. paraguayense* are different. The former prefers mountanous zones, "at an altitude of several thousand feet" (Macbride), according to our experience in collecting from Mediterranean type of vegetation. On the other hand, *Craterium paraguayense* generally fructifies in tropical and subtropical zones.

Apart from distinguishing *Craterium paraguayense* and *Physarum newtonii* by their habitat, we have undertaken a morphological comparation of the two species. Thus, the type material of Spegazinni has been solicited from the herbarium LPS and we have used this opportunity for making a repeated study of the type specimen of *Craterium rubescens* Rex, a synonymous species of *Craterium paraguayense*. The original descriptions of these species are given, because of their antiquity and the difficulty in obtaining the journals in which they were published.

MATERIALS AND METHODS

SEM micrographs were prepared using a Zeiss DSM-950 microscope. Spore samples were rehydrated with 100% NH_4OH for 30 min, then dehydrated in aqueous ethanol solutions (70%) for 1-1.5 h, before fixation in pure ethylene glycol dimethyl ether (1,2 dimethoxy-methane) and immersion in acetone for at least 2 h. The spores were subsequently critical-point dried, mounted onto an aluminium stub, and coated with gold-palladium in a Polaron E-5000 sputter coater for 2 min at 1.4 kV and 18 mA (argon atmosphere), creating a metal coating approximately 50 nm thick. Samples for light microscopy were mounted in Hoyer´s medium.

The spore wall ornamentation as seen in the SEM is described according to the terminology proposed by Rammeloo (1975a, b). The new records studied are deposited in the herbarium AH.

TAXONOMY

***Physarum newtonii* T. Macbr.**, *Bull. Lab. Nat. Hist. Iowa State Univ.* 2: 390. 1893. **Figs. 1-4**

Material examined. **SPAIN. Barcelona**: on leaves of *Quercus faginea* Lam., Olzinelles, 18-X-1995, *leg.* M. Lizárraga & G. Moreno, AH 19507. **Girona** (new record for this province): on leaves of *Quercus ilex* L., Riells, 25-X-1994, *leg.* G. Moreno & C. Illana, AH 21220 and AH 21221 (mixed with *Craterium leucocephalum* and *Didymium squamulosum*).

Other spanish records: On bark of *Pinus mugo* ssp. *uncinata* (DC.) Domin, El Collell (1845 m.), Gresolet, Barcelona, 27-IX-1977, *det.* E. Gracia, EG 379 in BCC. On leaves of *Quercus ilex* L., Font Grogue (350 m.), Sant Cugat del Vallés, Barcelona, 20-XI-1976, *leg.* X. Llimona, *det.* E. Gracia, EG 192 in BCC. On leaves of *Quercus coccifera* L. and *Pinus halepensis* Miller, Coto Cehegín, Cehegín, Murcia, 16-IV-1978, *det.* E. Gracia, EG 665 in BCC.

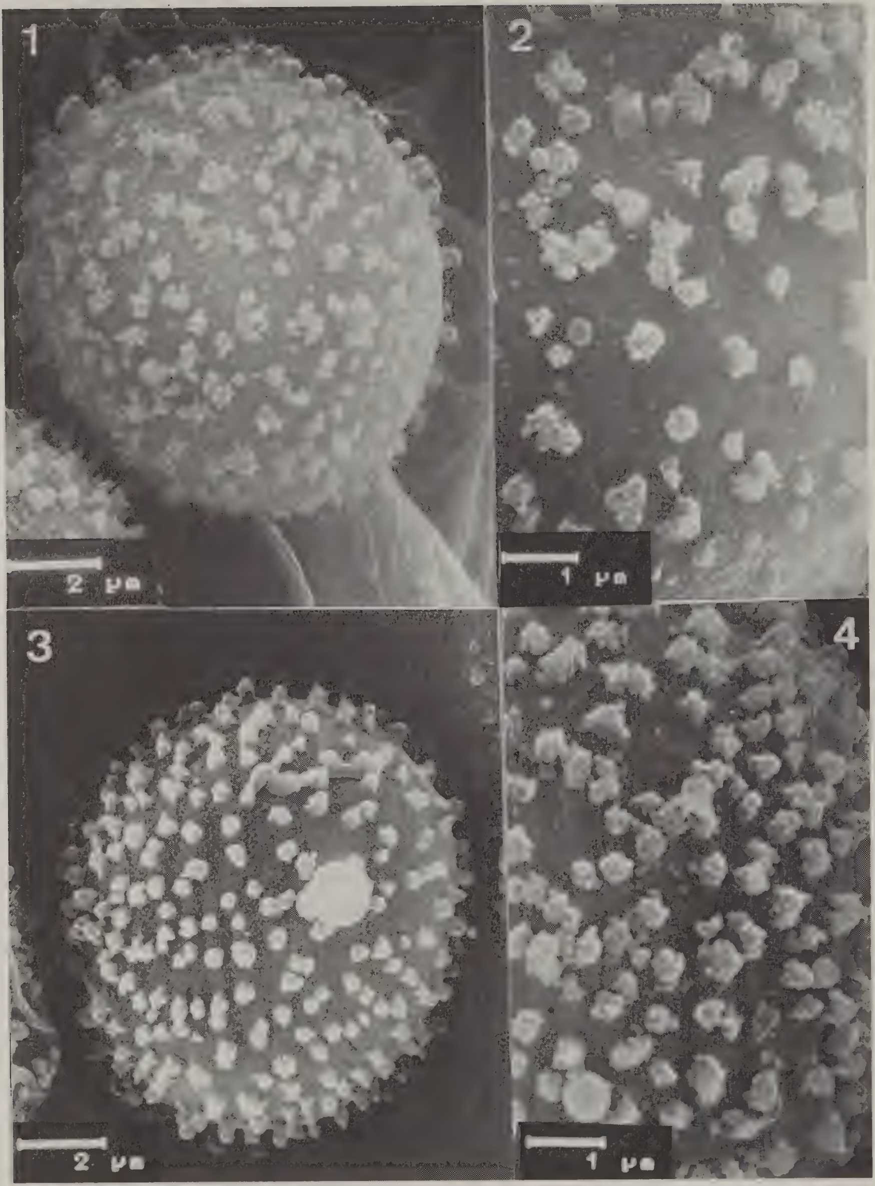
USA. On leaves and twigs (not determined), Colorado, BPI 808000 (on the herbarium box seems to be written: "teste Macbride" and "Type ?"). Colorado, *leg.* G. W. Newton, Wingate collection, BPI 808005 (without sporocarps). On leaves of holm-oak, Waldera Canyon, Arizona, 10-IX-1980, M. Blackwell- R.L. Gilbertson - Collection, BPI 807988.

Description. Sporocarps gregarious, stalked or occasionally sessile, 0.6-1.2 mm in total height. Sporotheca globose or subglobose, sometimes umbilicate above, pink-purple to dark violet, 0.4-1 mm diam. Hypothallus small, dark purplish. Stalk, when present, erect, longitudinally striate, dark, 0.2-0.5 mm in height. Peridium membranous, smooth, with lime granules, pink-purple, dark above, dehiscence irregular. Remains of peridium in the lower part of the sporotheca. Columella absent. Capillitium abundant, physaroid, with large, angular and purple nodes. Spores free, purplish back in mass, dark purplish with a paler area by transmitted light, globose, (9-)10-11(-12) µm diam., irregularly and prominently warted, under SEM the ornamentation is formed by thick and strong prominent baculae.

Remarks. *Physarum newtonii* is identified by its generally short-stalked sporocarps, its violet tinted peridium, its capillitium having large purple nodes and its dark, spinose spores.

The type material, other American specimens and the Spanish collections are very similar. Only the sample AH 21220 has somewhat larger spores (11-12 µm in diam.) and stronger spines. Generally, the sporocarps of our material are less violaceous than the specimen BPI 808000 and bear more calcium carbonate in their peridium; the other characters are coincident.

Distribution of *P. newtonii* in Spain. *Physarum newtonii* is cited in the Spanish catalogue of S.E. of the province Murcia by LÓPEZ-SÁNCHEZ et al. (1986). This material was collected in the course of the doctoral thesis of GRÀCIA (1981), who also cites collections from the province of Barcelona. Recently, records from the province of Valencia were made by OLTRA (1996). The specimens of Girona are the first from this Spanish province.



FIGS. 1-4. **Figs. 1-2:** ***Physarum newtonii***, BPI 808000. 1. Spores under SEM. 2. Detail of spore ornamentation. **Figs. 3-4:** ***Physarum newtonii***, AH 19507. 3. Spores under SEM. 4. Detail of spore ornamentation.

Craterium paraguayense **(Speg.) G. Lister** in Lister, *Monogr. Mycet.* Ed. 2: 95. 1911. **Figs. 8-11**

= *Didymium paraguayense*, Speg., *Anal. Soc. Ci. Argent.* 22: 186. 1886.

Material examined. PARAGUAY. Guarapí, on dead leaves of *Luehea grandiflora* Mart., XI-1881, *leg.* Balansa n° 3427, Type n° 31530, Universidad Nacional de la Plata, Museo-Instituto Spegazzini (LPS). Brasil: Amazonas, 12-1977, coll. Dumont, *det.* M. L. Farr, BPI 812964.

Original diagnosis. *Sporangia primo globosa v. elliptico-elongata (0,5-1''' x 0,5'''), sessilia rarius breviter substipitata, pulchre intenseque violacea, hypothallo mucedineo, fusco, tenuissimo, effuso insidentia laxeque adnata, dein hemisphaerica v. reniformia (1-2''' long x 0,8-1''' lat.), sessilia, subrepentia, cute candido, crasso, rimose v. frustulatim dehiscente tecta, gleba fulva v. pallide cervina farcta. Capillitium tenuissimum, hyalinum, non evanescens; sporae globosae (7-8 diam.), laevissimae, dilute fusco-olivaceae v. tabacinae. Granula calcarea numerosissima, minutissima, hyalina, globulosa v. irregulariter angulosa.*

Hab. Ad folia dejecta nec non ad cortices putrescentes Luheae grandiflorae prope Guarapí, Nov. 1881 (sub n. 3437).

Remarks. The type material is in very poor condition: The sporocarps are crushed and badly formed. Therefore we were unable to realize any macro- or microscopic study. In the paper which wraps up the specimen, drawings and notes of the observed characters can be found, made by Spegazzini himself. Among them are six sketches of spores with the notice "*7-8 µm*", as well as a drawing of small circles representing "*granula calcarea*", and a third illustration of a elongated sporocarp, sessile and lengthwise opened, with the note beneath: "*Sporangia primo ....*". Likewise the paper bears the number 3427, and not 3437, which is cited in the original diagnosis (possibly as a mistake).

Craterium paraguayense is characterised by its more or less elongated sporocarps, bright lilac to dark purple, its "physaroid" purple capillitium, and its purple stalk without calcium carbonate.

Comparing Spegazzini's description of the type with descriptions of this species by classic authors and with studies of different material, it can be concluded that the actual concept of *Craterium paraguayense* does not coincide with that of Spegazzini. In the original description the author indicates sessile or rarely stalked sporocarps, as well as a hyaline capillitium, and does not mention the presence of a columella, placing this taxon in the genus *Didymium*. One of the first monographs of Myxomycetes (MASSEE, 1892) indicates that *Didymium paraguayense* (not combined at that time with

Craterium) is a sessile species, rarely bearing a short stalk, with a delicate, hyaline capillitium and spores 7-8 µm in diam.; this description is similar to that of Spegazzini. However, it seems strange that Spegazzini did not include his species in the genus *Craterium* (a well known genus at this time, proposed in 1797), but in *Didymium*, although per his description, Spegazzini seemed to be right. REX (1893) proposed the new species *Craterium rubescens*, which nowadays is considered to be a synonym of *C. paraguayense*. This synonymy was proposed by LISTER (1894), who had studied the material of *Didymium paraguayense* collected by Spegazzini from Paraguay, namely specimen BM 1002, which is iconographed in the cited publication. Later JAHN (1904) proposed the genus *Iocraterium* for *Craterium rubescens*, considering the pseudocolumella of *Craterium rubescens* to be a genuine columella. Four years later TORREND (1908) followed the interpretation of Jahn and made the combination of the genus *Iocraterium* for *Didymium paraguayense*. Finally, LISTER (1911) does not use the genus *Iocraterium* proposed by Jahn, and places *Didymium paraguayense* in the genus *Craterium*.

These combinations are accepted by HAGELSTEIN (1944), MARTIN & ALEXOPOULOS (1969), FARR (1976), EMOTO (1977) and all subsequent monographers.

Distribution. Tropical and subtropical (MARTIN & ALEXOPOULOS, 1969, FARR, 1976, KELLER & BRAUN, 1999), only known from North America, South America and Japan. There are no records from Europe.

***Craterium rubescens* Rex**, *Proc. Acad. Nat. Sci. Philadelphia* 45: 370. 1893.
Figs. 5-7

Material examined. USA. St. Martinsville, Louisiana, *leg.* A. B. Langlois, H. Ludoviciana 2327 ex N.Y.B.G., BPI 812966. Louisiana, *leg.* A. B. Langlois, *det.* Macbride, BPI 812983.

FIGS. 5-11. **Fig. 5: *Craterium paraguayense* (= *C. rubescens*)** B.M. 1002 *leg.* C. Spegazzini. **Figs. 6-7: *Craterium rubescens*,** BPI 812966 type of *C. paraguayense*. 6. Label of the herbarium box. 7. Label and herbarium material. **Figs. 8-11: *Craterium paraguayense***, BPI 812983. 8. Spores under SEM. 9. Detail of spore ornamentation. 10. Label of the herbarium box. 11. Herbarium material.

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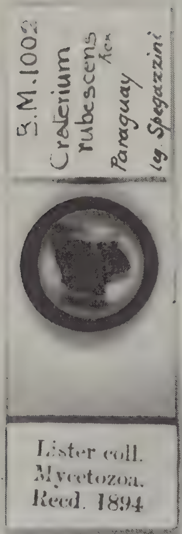
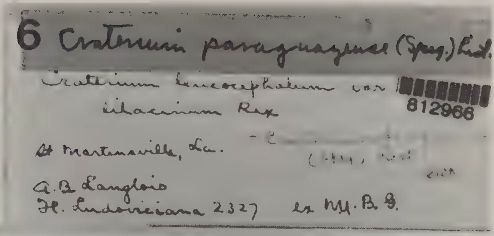


B.M. 1002
Craterium rubescens Rex
Paraguay
leg. Spegazzini

Lister coll.
Mycetozoa.
Recd. 1894

6



Craterium paraguayense (Speg.) List.

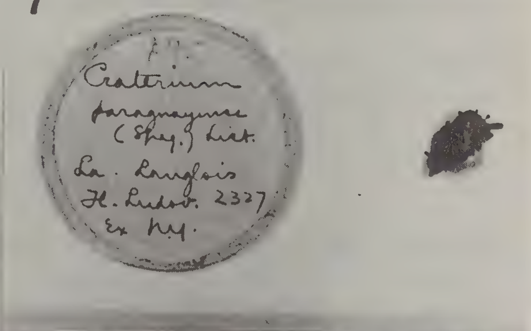
Cratterium leucocephalum var. ilhacinum Rex

812966

St Martinsville, La.

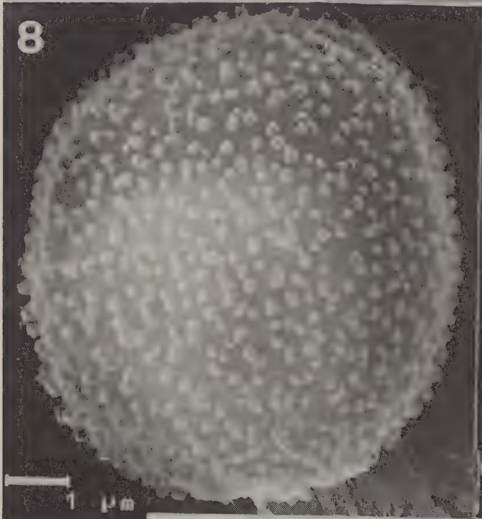
A.B. Langlois
H. Ludoviciana 2327 ex M.Y.B.G.

7



Crattrium paraguayense (Speg.) List.
La. Langlois
H. Ludov. 2327
Ex N.Y.

8



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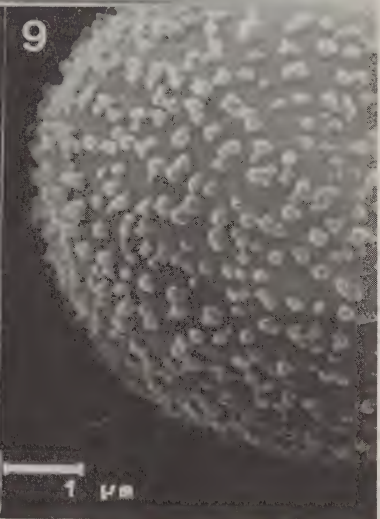

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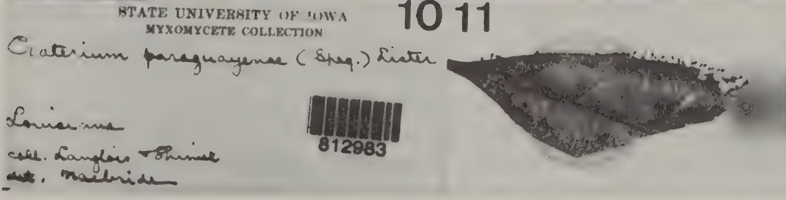

STATE UNIVERSITY OF IOWA
MYXOMYCETE COLLECTION

Craterium paraguayense (Speg.) Lister

Louisiana

coll. Langlois + Thiriat
det. Macbride

812983

11

Original diagnosis. “Sporangia stipitate, about one mm high including stipe, cylindroid or elongated cyathiform, apex convex; sporangium-wall single, dark violet-red, smooth except at the upper portion which is slightly roughened by an external deposit of scattered lime granules of a pale lilac color; lower third of wall ridged longitudinally; on spore dehiscence the apex falls away separating by an irregular line in a circumscissile manner; stipe violet-black, one-half the height of the sporangium, wrinkled longitudinally, the ridges being continuous with those upon the sporangium; capillitium composed of an irregular, branched central mass of violet-red lime granules, the branches connected with the sporangium-wall either directly or by a scanty network of delicate colorless tubules with long angular knots of red lime granules at the nodes; spores 7.5-8.5 μ in diameter, brown-violet, epispores thick, minutely warted with dark violet warts. Louisiana (A.B. Langlois, com. J.B. Ellis.)”.

Remarks. The distinctive features of this species are: Stalked sporocarps which are violet, cylindrical, with abundant capillitium and with a pseudocolumella. The spores, 7-9 μm in diam., globose, bright greyish, almost smooth or delicately warted, bearing under SEM numerous verrucae and small baculae of uniform distribution.

Rex did not indicate type material, but cited collections from the state of Louisiana. In response to our request for the type material of *Craterium rubescens* at BPI, the herbarium sent us two samples bearing the name *Craterium paraguayense* on their containers, without date, collected by A.B. Langlois; both from Louisiana. Thus, they correspond with the type material, to which Rex refers in his original diagnosis. We designate a new lectotype as the specimen BPI 812966.

DISCUSSION AND CONCLUSIONS

The comparative study of the types of *Physarum newtonii* and *Craterium paraguayense* is difficult due to the poor condition of the latter. LISTER (1894, 1911, 1925) indicated a certain similarity between *Physarum newtonii* and *Craterium paraguayense*, especially in the colour of the sporocarps, which we could also observe and which led us to initiate this study. Nevertheless, the form of the sporocarps is different, being globose in *Physarum newtonii* and cylindrical and/or in the form of a cup in *Craterium paraguayense*. Although there are specimens of *C. paraguayense* without the development of a pseudocolumella, it is typically present, in contrast to the absence of a pseudocolumella in *P. newtonii*. The spore ornamentation under SEM is very different in these taxa, presenting large, irregularly distributed baculae in *P. newtonii* (Figs. 1-4) and small verrucae or baculae of uniform distribution in *C. paraguayense* (Figs. 8-9).

The original diagnosis and our observations of the type material of *Craterium paraguayense* conserved in LPS, leaves some doubts in the characterisation of the species, as indicated above. Nevertheless, all doubt is resolved from our study of the material sent to Lister by Spegazzini; namely specimen BM 1002, which was studied and drawn by LISTER (1894). This material is conserved as a microscope slide, containing a small cylinder which includes a piece of leaf with five sporocarps (Fig. 5). This sample is conserved superbly and the external morphology of *Craterium paraguayense* can be confirmed. We therefore designate specimen BM 1002 as an epitype (interpretative type, Greuter & al., 1994, art. 9.7).

ACKNOWLEDGEMENTS

We are grateful to the curator of the herbaria BPI, K and LPS for the lending of some samples. We wish to express our gratitude to J.A. Pérez and A. Priego (Servicio de Microscopía electrónica, Universidad de Alcalá) for their invaluable help with the SEM. We express our gratitude also to Mr. D.W. Mitchell for their revisions and critical examinations of the manuscript.

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TWO ADDITIONAL SPECIES OF VERRUCISPOROTA, ONE WITH A MYCOSPHAERELLA TELEOMORPH, FROM AUSTRALIA

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Abstract: *Verrucisporota kimberleyana* sp. nov. is described as the causal agent of pepper spots on leaves of *Capparis sepiara* (Capparaceae). *Cercospora daviesiae*, which causes angular leaf spots on *Daviesia* spp. (Fabaceae), is recombined into *Verrucisporota* and its teleomorph described as *Mycosphaerella daviesicola* sp. nov.

Key words: *Daviesia*, *Capparis*, *Verrucispora*, Fabaceae, Capparaceae.

Introduction

The genus *Verrucispora* D.E. Shaw & Alcorn was erected by Shaw & Alcorn (1967) to accommodate a foliar pathogen, *Verrucispora proteacearum* D.E. Shaw & Alcorn, found on *Finschia chlorozantha* Diels in New Guinea and *Hakea florulenta* Meissn. in Queensland. It was distinguished from *Cercospora* mainly by the 'verrucose' nature of its conidia, although SEM studies have now demonstrated that the conspicuous ornamentation is actually rugose (David, 1997). When the name *Verrucispora* was subsequently found to be illegitimate, Shaw & Alcorn (1993) renamed the genus *Verrucisporota.* The only other species of *Verrucisporota* recognised by Shaw & Alcorn (1993) was *V. brideliae* (A.K. Sarbhoy, V.B. Hosagoudar & N. Ahmad) D.E. Shaw & Alcorn on *Bridelia retusa* Spreng. in India. The disposition of other previously proposed species of *Verrucispora* was clearly set out by Shaw & Alcorn (1993). Since that time, Braun (2000) has recombined *Passalora indica* Kamal & P. Kumar, from *Celastrus paniculata*, into *Verrucisporota indica* on account of its coarsely verrucose-rugose conidia.

In this paper a new species of *Verrucisporota*, *V. kimberleyana* sp. nov., is described from *Capparis sepiara* L., and *Cercospora daviesiae* Cooke & Massee from *Daviesia latifolia* R. Br. is recombined into *Verrucisporota,* its host range as *V. daviesiae* comb. nov. being extended to include *Daviesia mimosoides* R. Br. var. *laxiflora* (J. H. Willis) J.H. Willis. The *Capparis* specimens were all collected from the coast of the rugged Kimberley region of north-western Western Australia, whereas those on *Daviesia* were collected in temperate south-eastern Australia, usually in montane forests. The two new taxa are compared with *V. proteacearum*, the only other species of *Verrucisporota* known to occur in Australia. *V daviesiae* and *V. kimberleyana* apparently bring to five the known species of *Verrucisporota*. They satisfy the criteria by which *Verrucisporota* is distinguished from *Stenella* and *Sirisporium* (Shaw & Alcorn, 1993) in that they have stromata, their mycelium is immersed, their conidiophores are unbranched, and their conidia are solitary, only transversely septate and 'verrucose' [we had independently interpreted all three Australian species to show rugose or rugulose ornamentation as now confirmed for *V. proteacearum* by David (1997)]. *Mycosphaerella* ascomata and spermogonia are closely associated with conidiomata of *V. daviesiae* in a number of specimens and are subtended by the same brown intercellular hyphae as the conidiomata. The connection is considered sufficiently convincing to justify the acceptance of the *Mycosphaerella* state as the teleomorph of *V. daviesiae*.

Taxonomy

Verrucisporota kimberleyana Beilharz & Pascoe **sp. nov.** (Fig. 1)

Etym.: from the collection location, the Kimberley region of north-western Australia

Sporulatio hypogena. *Mycelium immersum* subhyalinum, 3–5 μm diam. *Mycelium superficiale* non visum. Stromata substomatalia, discreta, e textura angulare composita, prope basim perpallida, cellularum aliquot strata superficialia fusciora olivaceo-brunnea, 30–47 μm x c. 40 μm profunda. *Conidiophora caespitosa*, olivaceo-brunnea, ad apicem pallidiora, recta vel leviter curvata, usque ad 3–geniculata, ad apicem interdum verruculosa, divergentia, interdum 1–ramosa, usque ad 9–septata, 27–90 x 3–4 μm. *Loci conidiogeni* fuscati, leviter incrassati, 1–1.75 μm diam. *Conidia* recta vel levissime curvata, pallide olivacea, ± cylindracea vel anguste clavata, interdum constricta, rugosa, apice obtusa, basim truncatum versus deminuta, (0–)2–3 (–7) septata, 13–30(–77) μm longa x 2.75–4 μm lata. Hila leviter incrassata, fuscata, 0.75–1.5 μm diam.

Lesions hologenous, scattered, discrete, necrotic, circular or more often irregular, light brown bordered by a raised, thin, black margin on the lower leaf surface, similar on the upper surface or having a darker centre, mostly c. 1 mm diameter. *Sporulation* hypogenous. *Immersed mycelium* subhyaline, sparse, 3–5 μm diam. *Superficial mycelium* not seen. *Stromata* substomatal, discrete, compact, at maturity protruding slightly from the stoma and sometimes spreading a little laterally beneath the epidermis; composed of *textura angularis*, very pale near the base, the upper several cell layers being a darker olivaceous brown, 30–47 μm wide x c. 40 μm deep. *Conidiophores* caespitose, olivaceous brown at the base, paler at the apex, straight or slightly curved, with up to three geniculations at the apex associated with sympodial proliferations, smooth at the base but with occasional verruculose patches higher up, divergent, occasionally once-branched, up to 9-septate, 27–90 x 3–4 μm. *Conidiogenous loci* darkened and slightly thickened, 1–1.75 μm diam. *Conidia* straight or very slightly curved, pale olivaceous, ± cylindrical or narrowly clavate, sometimes constricted at the septa, rugose, with an obtuse apex and tapering to a truncate base, (0–)2–3(–7) septate, 13–30(–77) μm long x 2.75–4 μm wide. *Hila* slightly thickened and darkened, 0.75–1.5 μm diam.

Holotype: **Australia**: on living leaves of *Capparis sepiara* (Capparaceae), W.A., Kimberley region, *R. Eichner*, 15 May 1998, VPRI 21876.

Additional specimens examined: **W.A.:** *Capparis sepiara*, Kalumburu, Truscott airfield, *R. Eichner*, 19 June 1987, VPRI 21541a; Truscott, barge landing, *R. Eichner*, 20 July 1999, VPRI 22089; Dampier Peninsula, One Arm Point, *R. Eichner*, 27 July, 1997, VPRI 21597.

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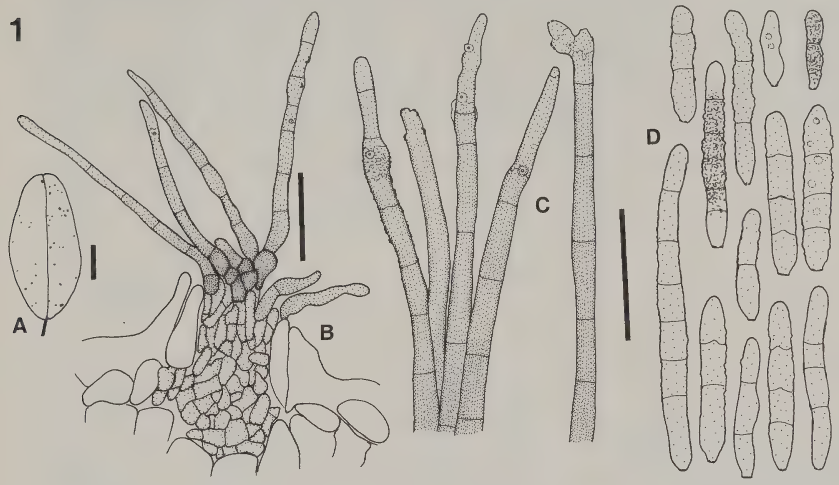


Fig. 1. ***Verrucisporota kimberleyana***
A, leaf (VPRI 21541); B, XS conidioma (VPRI 21541); C, conidiophores (VPRI 21597); D, conidia (VPRI 21597). All fungal parts from abaxial leaf surface.
Bars = 10 mm (A), 20 µm (B–D).

V. kimberleyana differs from other cercosporoid species described from *Capparis*. Three taxa with ornamented conidia have been published in *Stenella*, namely *Stenella capparidis* Kamal, Singh & Kumar, *Stenella capparidicola* (Hansford & Thirumalachar) Mulder and *Stenella capparidiicola* S.K. Singh, Archana Singh & Kamal. The latter binomials are homonyms (*S. capparidicola* (Hansford & Thirumalachar) Mulder has priority), and from the illustrations of both taxa (Mulder, 1982; Singh, Singh & Kamal, 1997), appear to be taxonomic synonyms. *V. kimberleyana* differs from all the described *Stenella* taxa by its lack of superficial hyphae, its shorter and narrower conidia and differences in conidiophore morphology. The pigmented, rough-walled conidia and septate conidiophores of *V. kimberleyana*, among other characteristics, distinguish it from taxa with smooth-walled conidia, namely *Cercospora capparidis* Sacc. (Chupp, 1954, Vasudeva, 1963) and *Neoramularia capparidis* Bagyan., U. Braun & B. Sutton (Bagyanarayana, Braun & Sutton, 1994). We have examined a specimen of *C. capparidis* from an exsiccatum of Briosi and Cavara held at VPRI (Fascicle III–IV, No. 84). The conidiomata were immature and still immersed, and no conidia were found. However, the leaf spots, although small (1–2 mm), were considerably larger and of a different appearance to those caused by *V. kimberleyana*.

The numerous stromata were tightly clustered in the centre of the lesions, and they too were much larger than the inconspicuous stromata of *V. kimberleyana*.

The stromata of *V. kimberleyana* are very pale at the base, only the upper several cell layers being a darker olivaceous, thereby differing from the generic description of *Verrucisporota* in which stromata are rufous-brown. Given that some stromatic cells are appreciably pigmented, however, the fungus is not disqualified from its placement in *Verrucisporota*. The cell walls of all parts of *V. proteacearum* are much darker than those of the *Verrucisporota* on *Daviesia*, which in turn is darker than *V. kimberleyana*. This variation in depth of conidium pigmentation is largely owing to substantial differences in conidium wall thickness between the three species (Fig. 2).

Verrucisporota daviesiae (Cooke & Massee) Beilharz & Pascoe **comb. nov.** (Fig. 3)

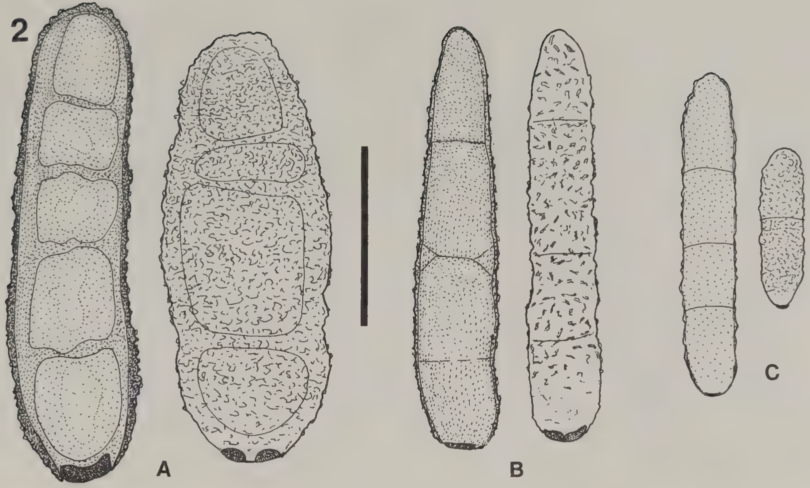
Cercospora daviesiae Cooke & Massee (1889), *Grevillea* **18**: 7.

Anamorphic stromata barely filling the substomatal cavity, discrete, brown. *Conidiophores* caespitose, emerging from the stomata, mid-brown, slightly paler towards the apex, rigid, thick-walled, ± cylindrical, straight or slightly curved or bent, unbranched, smooth at the base becoming rugulose towards the apex, 0–3 septate, 16–65 μm long x 5–7 μm wide. *Conidiogenous loci* 1–3, broad, dark, thickened, protuberant or not, remaining on slight shoulders or flat against the side wall following 1–3 enteroblastic sympodial proliferations of the conidiogenous cell, 4–5 μm diam. *Conidia* cylindrical to obclavate, straight or slightly curved, rugose, light brown, often paler and smoother towards the apex, sometimes smoother towards the base or with a smooth patch elsewhere, 0–6 septate, sometimes constricted at the septa, apex broadly obtuse, base truncate, 18–56 μm long, 4.5–7 μm wide. *Hila* dark, thickened, 2–5 μm diam.

Holotype: **Australia**: *Cercospora daviesiae* Cooke & Massee, on fading leaves of *Daviesia latifolia* R. Br. (Fabaceae), Victoria., Wm. Martin, No. 438, Herb. K.

Fig. 2. ***Verrucisporota* spp.** Conidia of the three species of *Verrucisporota* known in Australia, each shown in optical section and surface view: A, *V. proteacearum*; B, *V. daviesiae*; C, *V. kimberleyana*. Bar = 20 μm

Fig. 3. ***Verrucisporota daviesiae***
A, leaf (VPRI 16400); B, conidia (VPRI 16409); C, conidiophores and conidiogenous cells, three with attached conidium initials (long conidiophore VPRI 21366, others VPRI 16409d); D, XS conidioma (VPRI 17431); E, immersed hypha with mucilaginous coating. All reproductive parts from adaxial leaf surface except long conidiophore and conidioma. Bars = 10 mm (A), 20 μm (B–E).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A
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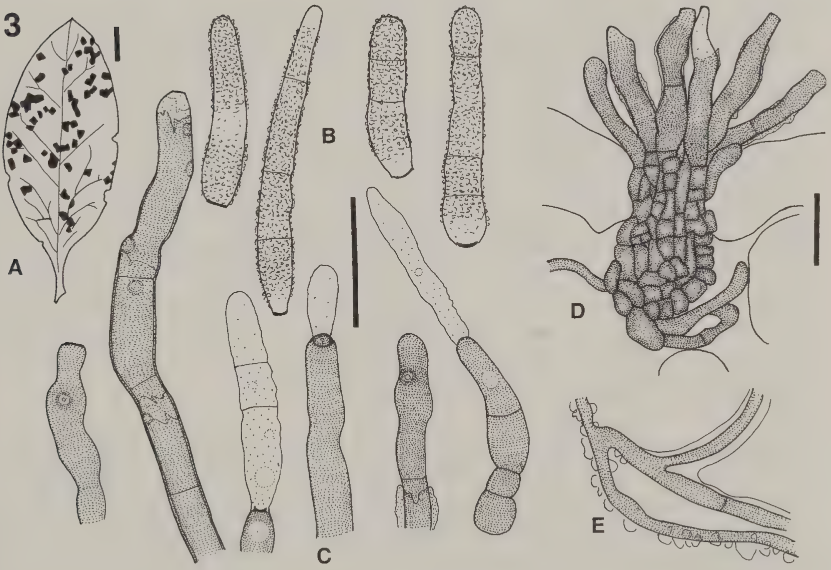
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A
B
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Additional specimens examined:
Victoria: *D. latifolia*, Mt Buffalo, Porepunkah-Mt Buffalo Rd, just below McKinnon's Corner, *V. & R. Beilharz*, 14 Nov. 1988, VPRI 16400a; ibid, VPRI 17427; ibid, VPRI 17430; *D. latifolia*, Mt Samaria State Park, 7 km S of Camphora campsite turnoff, *V. & R. Beilharz*, 17 Nov. 1988, VPRI 17429; *D. latifolia*, Mt Samaria State Park, 7.6 km S of Camphora campsite turnoff, *V. & R. Beilharz*, 8 Feb. 1989, VPRI 17431; *D. latifolia*, Alpine N.P., near Mt Howitt, Stanley's Name Spur walking track, *V. & R. Beilharz*, 31 Mar. 1991, VPRI 17434; *D. latifolia*, 19 km from Orbost on the Bonang Rd, *V. & R. Beilharz*, 21 Feb. 1993, VPRI 21366; *D. latifolia*, Alpine N.P., Upper Howqua R. valley, *V. & R. Beilharz*, 12 Apr. 1993, VPRI 21369; *D. latifolia*, Genoa, between Princes Hwy and Genoa Peak walking track, *V. & R. Beilharz*, 13 Dec. 2000; D. *mimosoides* var *laxiflora*, Alpine N.P., near Mt Howitt, Stanley's Name Spur, *V. & R. Beilharz*, 1 Apr. 1991, VPRI 17435a; *D. mimosoides* var *laxiflora*, ibid, VPRI 17434; *D. mimosoides* var *laxiflora*, Alpine N.P., Upper Howqua R., high up on Bluff Link Rd, *V. & R. Beilharz*, 25 Mar. 1989, VPRI 16402. **N.S.W.**: *D. latifolia*, Morton N.P., Fitzroy Falls, *V. & R. Beilharz*, 3 Nov. 1997, VPRI 21626a. **Tasmania**: *D. latifolia*, Fairfield, near Campbell Town, *H.-Y. Yip*, 10 Jan. 1988, VPRI 15910.

Conidia of *C. daviesiae* were described in the literature as 60 x 4 µm, 5–septate (Cooke & Massee 1889) and 20–60 x 4.5–5 µm, 3–5 septate (Chupp, 1954). Our measurements from the type specimen (K), 8–56 x 4.5–7 µm, 0–6 septate, slightly extended the maximum width and degree of septation. Oddly, neither Cooke (1989) nor Chupp (1953) mentioned the conspicuously rough conidium walls of the type specimen, which are a feature also of the recent collections. The rugosity of the conidium walls precludes the fungus from being placed in *Cercospora*, but is in agreement with the description of *Verrucisporota* (as *Verrucispora*) (Shaw & Alcorn, 1967). No other cercosporoid fungus appears to have been described for *Daviesia* spp. *V. daviesiae* has markedly narrower conidia (4.5–7 µm) than *V. indica* (7–11 µm), *V. proteacearum* (5.5–10 µm) and *V. brideliae* (6–10 µm), and markedly broader conidia than *V. kimberleyana* (2.75–4 µm). *V. kimberleyana* clearly stands apart from the other species in terms of conidium diameter alone. Conidia of *V. proteacearum*, *V. daviesiae* and *V. kimberleyana* are illustrated in Fig. 2.

Many lesions in the holotype of *Cercospora daviesiae* contained ascomata as well as conidiomata. Recent collections of *Daviesia* spp. showed both ascomata and spermogonia intermixed with conidiomata in some lesions, while other lesions were predominantly or entirely ascal or conidiomatal. The three types of fruiting body were subtended by similar brown intercellular hyphae. In all specimens the ascomata varied in maturity, and mature asci (Fig. 4B) and ascospores (Fig. 4C) were uncommon. Those illustrated in Fig. 4C (VPRI 17435b) showed marked constrictions at the septa, whereas those from the holotype of *C. daviesiae* (Fig. 4A), which were faint in outline and clearly immature, were of similar dimensions but lacked the constrictions. We believe the latter ascospores to be immature examples of those found in VPRI 17435b. As neither ascomata nor spermogonia have been described for *V. proteacearum*, *V. brideliae* or *V. indica*, this appears to be the first reported teleomorph for a species of *Verrucisporota*.

proteacearum, *V. brideliae* or *V. indica*, this appears to be the first reported teleomorph for a species of *Verrucisporota*.

The *Mycosphaerella* teleomorph of *V. daviesiae* differs from *Mycosphaerella daviesiae* Petrak described from dry twigs of *Daviesia latifolia* collected in N.S.W., Australia (Petrak, 1954). Our examination of the type specimen (GZU) confirmed Petrak's description of small subepidermal ascomata densely distributed on the twigs. There was no associated anamorph. Most ascospores (seen within asci) conformed with the dimensions given by Petrak (7–10 µm, rarely up to 13 µm long, 3–3.5 µm wide). A few were 18 µm long, similar in length to those of the *V. daviesiae* teleomorph, but much broader (4.5–5 µm as compared with 3–3.75 µm). The ascospores of *M. daviesiae* (Fig. 4D) had obtuse ends and little if any constriction at the septa in comparison with those of the *V. daviesiae* teleomorph (Fig. 4C) which were much narrower, somewhat attenuated towards the apices and markedly constricted at the septa. We therefore describe the teleomorph of *V. daviesiae* as a new species, *Mycosphaerella daviesicola*.

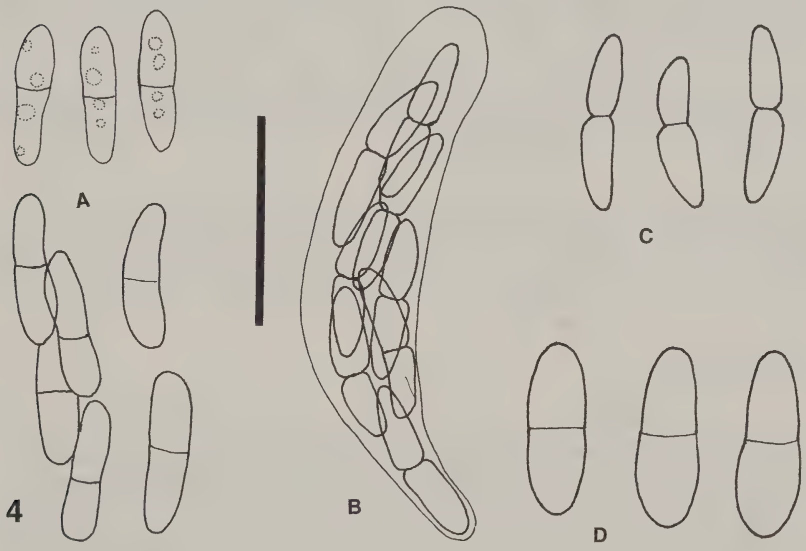

Fig. 4. ***Mycosphaerella*** species on *Daviesia latifolia*
A, immature ascospores of *Mycosphaerella daviesicola* from the type specimen of *Verrucisporota daviesiae*; B–C, ascus and mature ascospores of *M. daviesicola* (holotype); D, ascospores of *Mycosphaerella daviesiae* (holotype). Bar = 20 µm.

Mycosphaerella daviesicola Beilharz & Pascoe **sp. nov.** (Fig. 4A-C)

Anamorph: *Verrucisporota daviesiae* (Cooke & Massee) Beilharz & Pascoe

Differt a *M. daviesiae* ascosporis 3–3.75 μm latis, apicem versus attenuatis et septis distincte constrictis.

Lesions hologenous, necrotic, angular, vein-limited, up to 5 mm diam., larger when confluent, light brown, often with a narrow, raised, darker margin. *Immersed mycelium* brown, branched, regularly septate, 1.5–3 μm diam., with a smooth or rough pale brown coating; superficial mycelium not seen. Ascomata, spermogonia and conidiomata amphigenous, always associated with stomata. *Ascomata* substomatal, brown, subglobose, uniloculate, walls composed of textura angularis, c. 87 μm wide x 95 μm deep, neck 10 μm long. *Asci* aparaphysate, fasciculate, bitunicate, subsessile, ovoid to obclavate, straight to curved, 8-spored, c. 52 x 18 μm. *Ascospores* hyaline, 2–3 multiseriate, overlapping, equally to unequally 2-celled, attenuated towards the apices, 15–19 x 3–3.75 μm. *Spermogonia* substomatal, uniloculate, ca 55 μm deep x 48 μm wide, neck 15 μm long. Spermatia cylindrical, c. 3 x 1.25 μm.

The walls of the ascomata and spermogonia were concolorous with the darkest cells of the anamorphic stromata.

Holotype: **Australia**: On living leaves of *Daviesia mimosoides* R. Br. var. *laxiflora* (J. H. Willis) *J.H. Willis*, Victoria, Alpine N.P., near Mt Howitt, Stanley's Name Spur, *V. & R. Beilharz*, 1 Apr. 1991, VPRI 17435b.

Additional specimens examined: **Victoria**: *D. latifolia*, Mt Buffalo, Porepunkah-Mt Buffalo Rd, just below McKinnons Corner, *V. & R. Beilharz*, 14 Nov. 1988; VPRI 17430; *ibid*, VPRI 16400a; *D. latifolia*, Alpine N.P., near Mt Howitt, Stanleys Name Spur walking track, *V. & R. Beilharz*, 31 Mar. 1991, VPRI 17434; **NSW**: *D. latifolia*, Morton N.P., Fitzroy Falls, *V. & R. Beilharz*, 3 Nov. 1997, VPRI 21626b.

Acknowledgments

We thank J. Alcorn (BRIP) for confirming the generic disposition of *Verrucisporota daviesiae*, and R. Eichner for supplying the *Capparis* specimens. The curators of BRIP, K and GZU are thanked for kindly loaning specimens. We acknowledge with thanks the correction and composition of Latin diagnoses by A.P. Moss, and thank U. Braun for his helpful comments on the manuscript. The first author gratefully acknowledges the support provided by an Australian Postgraduate Award during the initial stage of this study, and the ongoing support of the Australian Biological Research Study which allowed the work to be further developed and brought to a conclusion.

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A NEW SPECIES OF ASCOCHYTA FROM LEAF SPOTS ON PEPEROMIA SPP. IN BRAZIL

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ABSTRACT

A species of *Ascochyta* found associated with leaf spots on two species of Peperomiaceae, *Peperomia sandersii* and *Peperomia* sp., in Brazil is newly described herein. The fungus is named *Ascochyta peperomiae.* This is the first species of *Ascochyta* to be described in association with plants in the family.

KEYWORDS: Peperomiaceae, Coelomycetes, ornamentals, taxonomy

INTRODUCTION

Peperomia spp. is a large genus of tropical to subtropical herbaceous plants having a distribution which is mostly concentrated in the Americas. They belong to the family Peperomiaceae which used to be treated as a part of the closely related family Piperaceae (Hutchinson, 1973; Heywood, 1985; Lorenzi & Souza, 1995). Being shade tolerant, several species of the genus *Peperomia* are popularly cultivated as ornamentals and foliage pot plants (Löfgren, 1917; Lorenzi & Souza, 1995).

A damaging leaf spot disease was observed attacking a group of *Peperomia sandersii* C. DC plants growing in the Botanic Garden of the Universidade Federal de Viçosa (Minas Gerais, Brazil) in 1998. Two years later, a natural population of diseased *Peperomia* sp. indet. showing similar symptoms were found at a site close to the Iguaçu Falls (Foz do Iguaçú, Paraná, Brazil).

The present paper describes the fungus associated with these symptoms and the tests conducted to verify its pathogenicity.

MATERIAL AND METHODS

Isolation and characterization

Isolates were obtained by surface sterilizing selected leaf fragments (periphery of necrotic lesions) in 2% sodium hypochlorite. Fragments were then plated on a vegetable broth-agar medium – VBA (Pereira, 1997). Pure cultures were grown in Petri dishes containing VBA for seven days at 25°C under near UV light (12 h photoperiod). These cultures were used to describe the morphology of the fungus together with the herbarium material. Drawings and descriptions were made with the aid of a Leitz Laborlux S light microscope fitted with a drawing tube.

Pathogenicity test

The isolates obtained from *P. sandersii* were used for testing pathogenicity on healthy, potted plants. The pycnidiospores suspension (5×10^6 spores/ml) was sprayed, until incipient run off, on the abaxial and adaxial leaf surface of three plants. A similar set of plants sprayed with water served as a control. In another test, sections of freshly harvested diseased leaf tissues were attached to the leaf surface of the healthy plants. All the plants were transferred to a dew chamber for 48 h at 25°C and then to the greenhouse bench. The plants were examined weekly for symptom development.

RESULTS AND DISCUSSION

Ascochyta peperomiae J. M. Pereira & R. W. Barreto sp. nov. (Fig. 1)

Laesiones in foliis vivis; amphigenae, 2-12 mm, circularis, brunneus, zonatus, concentricus. *Mycelium immersum* 1-2 µm diam, intracellulosum, ramosum, septatum, hyalinae ad pallidum brunneum. *Mycelium superficiale* absens. *Conidiomata* pycnidialia, immersa, solitaria vel subsolitaria, globularis, 84.0-158.0 µm, textura angularis, 9.0-27.0 µm stratis cellularum, atro-brunneae, ostiolum centralis, 6.0-10.5 µm diam. *Conidiophora* absens. *Cellulae conidiogenae* discretae, enteroblasticae, ampulliformes, 4.0-15.0 x 3.0-8.5 µm, hyalinae. *Conidia* viscidus, cylindrica, 10.5-28.0 x 3.5-7.0 µm, 1 septata, guttulata, hyalina, laevis.

Holotypus. Brazil: VIC 22044, on *Peperomia sandersii*, Horto Botânico UFV, Viçosa, MG, 21 September 1998.
Paratypus. Brazil: VIC 22140, on *Peperomia* sp., Parque Nacional do Iguaçu, close to the Iguaçu Falls, Foz do Iguaçu, PR, 07 January 2001.

Lesions on living leaves, 2-12 mm diam, circular, necrotic, brown abaxially and light brown to redish brown, with concentric zonation, surrounded with a dark brown to black ring adaxially. *Internal mycelium* intracellular, 1-2 µm diam, branched, septate, hyaline to pale brown. *External mycelium* absent. *Conidiomata* pycnidial, amphigenous, immersed, solitary or in groups of 2 or 3, globose, 84.0-158.0 µm diam, walls of *textura angularis*, 9.0-27.0 µm thick, dark brown. *Dehiscence* ostiolate, central, circular, 6.0-10.5 µm. *Conidiophores* absent. *Conidiogenous cells* discrete, enteroblastic, ampulliform, 4.0-15.0 x 3.0-8.5 µm, hyaline. *Conidia* slimy, cylindrical, 10.5- 28.0 x 3.5-7.0 µm, 1 septate, guttulate, hyaline, smooth.
Minor size differences were observed in the specimen from Foz do Iguaçu. It had smaller pycnidia (49.5-93.0 µm diam) with slightly thinner walls (7.0-24.0 µm thick).
In culture relatively fast growing (8 cm diam after 7 days), colonies composed of white to light grey cottony aerial mycelium with concentric diurnal zonation, sporulating pycnidia abundantly formed.

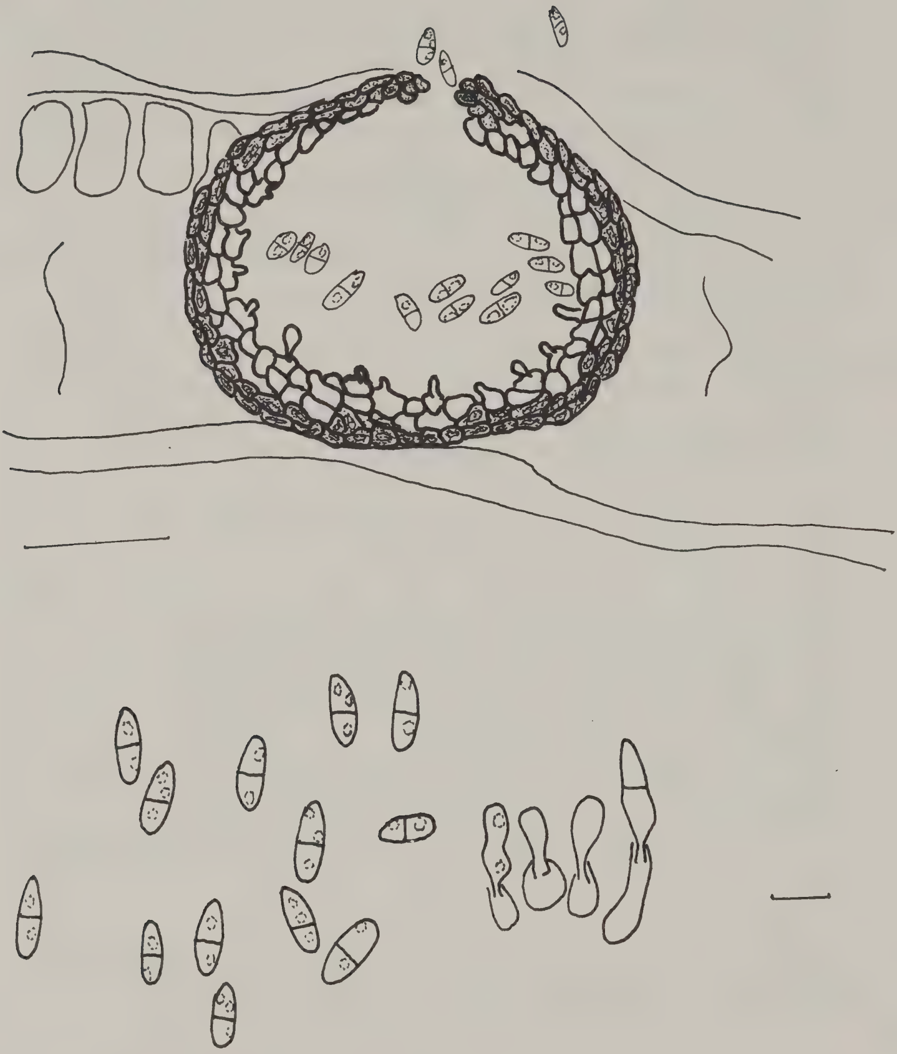

Fig. 1- A, Vertical section of pycnidial conidioma; B, Conidiogenous cells and conidia (Bars A = 50µm; B= 10µm)

There is no record of *Ascochyta* spp. or related genera on *Peperomia* or other member of the Peperomiaceae. The only full record of a member of this genus associated with plants in the Piperaceae is *Ascochyta piperina* Syd. on *Piperis tungurahuae* Sodiro (Sydow, 1939). *Ascochyta piperina* is clearly distinct from the new species reported here, having smaller conidia and attacking a member of a different host genus. Alfieri Jr. et al. (1989) reported the occurrence of *Ascochyta* sp. on *Peperomia obtusifolia* (L.) A. Dietr in Florida, USA, but no information on morphology of this fungus was provided. Only one species of pycnidial coelomycete, *Phomopsis peperomiae* Ali & Saikia, is known in association with *Peperomia* sp. (Ali & Saikia, 1993). Fungi in this genus can easily be distinguished from members of *Ascochyta* as they have unicellular (and often dimorphic) conidia and well developed conidiophores. Morphological data of the fungi cited are given in Table 1 for comparison

Table 1- Morphological characteristics of species of coelomycetes associated with Peperomiaceae and Piperaceae

Characters	*Phomopsis peperomiae* (Ali & Saikia, 1993)	*Ascochyta piperina* (Sydow, 1939)	*Ascochyta peperomiae*
Conidiomata:	pycnidial	pycnidial	pycnidial
Shape	globose to subglobose	globose	globose
Position	immersed	immersed	immersed
Diam.	156-234µm	120-180µm	84-158µm (49.5-93µm)
Conidiophores	present	absent	absent
Conidiogenous cell:			
Shape	-	-	ampulliform
Size	-	-	4-15 x 3-8.5µm
Conidia:			
Shape	fusiform to elliptical	oblong to cylindrical	cylindrical
Cells	unicellular	bicellular	bicellular
Size	4.9-10.5x2.4-3.2µm	5.5-10x 2.5-3.6µm	10.5-28x3.5-7µm
Distribution:	India	Philippines	Brazil

Pathogenicity test

Repeated attempts to prove that pathogenicity of this fungus were unsuccessful. Although Koch's postulates were not fulfilled, due to the wrong inoculation protocol, field observations clearly indicated that *A. peperomiae* is a primary leaf pathogen of *Peperomia* spp.

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TEICHOSPORACEAE, ANOTHER FAMILY IN THE PLEOSPORALES

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ABSTRACT

The family Teichosporaceae is proposed to include eight genera, most of them previously assigned to the lichenicolous Dacampiaceae. New species are described as *Byssothecium cholla*, *Sinodidymella americana*, and *S. hesperia*. New combinations are proposed for *Pleospora obiones* in *Byssothecium*, for *Trematosphaeria cactorum* in *Chaetomastia*, for *Didymosphaeria atraseptata* in *Immotthia*, and for *Melanopsammina utahensis* in *Sinodidymella*.

Keywords: Pleosporales, Teichosporaceae, systematics, saprotrophs

During the preparation of revised keys to members of the Pleosporales, several groups of genera required clarification. Investigation of coprophilous taxa resulted in the recognition that Sporormiaceae Munk 1957 belongs in the Pleosporales and is separate from both the Phaeotrichaceae Cain 1956 and the Delitschiaceae M.E. Barr 2000 both arranged in the Melanommatales (Barr 2000). The Montagnulaceae was recently segregated in the Pleosporales for taxa previously assigned to the Phaeosphaeriaceae M.E. Barr 1979 (Barr 2001). One additional group of genera must also be recognized. Barr (1987b, 1990b) had included saprotrophic fungi among the lichenicolous taxa of the Dacampiaceae Körb. 1855. The major differences in trophic states, peridium structure, and ascus morphology (Eriksson 1981, Crivelli 1983) of these fungi continue to plague the union. It seems preferable to keep the Dacampiaceae and its synonymous name Pyrenidiaceae Zahlbr. 1903 as a family of lichenicolous genera, with a few lichenized taxa, e.g., *Eopyrenula* R.C. Harris (Harris 1995) added, and to segregate the saprotrophic taxa, in woody stems and periderm or hypersaprotrophic in other ascomycetous fungi, as a newly recognized family.

Teichosporaceae M.E. Barr, fam. nov.

Ascomata similis vel Dacampiaceae praeter habitationes saprotrophicae in planta non lichenicola aut in ascomatis vel peridiis et ascis divergens. Genus typicus: *Teichospora* Fuckel 1870.

Ascomata immersed becoming erumpent to superficial, usually medium sized, rarely large, perithecioid, obpyriform, ovoid, or globose; apex wide and bluntly papillate, pore rounded, often eroded in age, at times thickened by radiating ridges, ostiole stuffed with pseudoparaphyses or in some species periphyses, whitish to yellowish or reddened at times; surface smooth or roughened by protruding cells or hyphal appendages, at times seated in hyphal subiculum that may be compacted as a thin stromatic crust; peridium three layered at least in part, of differing consistencies: outermost layer of small pseudoparenchymatous cells, walls thickened and often melanized, reddish brown or blackened on exposed surface, mid region visible especially toward apex or complete at times, of pallid, small, often thick-walled or scleroplectenchymatous cells, innermost layer narrow, of pallid, compressed rows of cells. Hamathecium of numerous, narrowly cellular pseudoparaphyses, rarely in gel matrix. Asci bitunicate, fissitunicate, in basal hymenium, cylindric to oblong, occasionally clavate, four to eight-spored or polysporous, endotunica narrow in upper region, with small apical oculus. Ascospores hyaline or shades of brown, versicolorous at times, then end cells pallid and shorter than mid cells, fusoid or ellipsoid, symmetric or somewhat asymmetric and obovoid; amero-, didymo-, phragmo-, or dictyosporous; surface smooth or verruculose or foveolate, gel coating rarely present; contents usually one or two globules or several minute guttules per cell; uniseriate or partially biseriate to crowded in the ascus. Anamorphs infrequent, where known coelomycetous; conidiogenesis phialidic; described as *Pyrenochaeta*, *Coniothyrium*, or *Chaetophoma*.

Saprotrophic on wood and periderm, also perennial roots, rhizomes, or stout culm bases of herbaceous plants, or hypersaprotrophic on other ascomycetous fungi.

Four pleosporalean families have a three-layered peridium, at least in part. The outermost layer in each is darkened and composed of several rows of pseudoparen- or scleroplectenchymatous cells. The mid region of smaller, less pigmented, often scleroplectenchymatous cells may be entire or more frequently is partial, developed toward either the basal or the apical region of the ascoma. The innermost layer is narrow, composed of compressed rows of cells that surround and support the hymenium. Most members of the Cucurbitariaceae G. Wint. 1885 have a deep mid-peridial basal region that tapers to the quite obtuse or plane apex that opens by a minute ostiole. The elongate ascomata in members of the Hysteriaceae Dumort. ex Corda 1842 open by a longitudinal slit, a readily recognized feature of the family. In vertical section, the entire aspect as well as peridial layers are similar in both the Hysteriaceae and the Cucurbitariaceae, as is the typical habitat on woody tissues. Members of the Montagnulaceae and of the newly described Teichosporaceae tend to form the greatest amount of mid-layer peridium tissues above the hymenium. In the Montagnulaceae the nearly globose ascomata are immersed in members of Agavaceae or small woody or herbaceous stems, in a well-developed hyphal subiculum that often forms a clypeus surrounding the short to well-developed papilla; ostioles are usually periphysate. The erumpent to superficial ascomata of members of the Teichosporaceae tend to be obpyriform or obovoid or globose, on woody substrates or over other ascomycetes. The upward taper in shape provides a rather wide blunt papilla; the ostiole is often stuffed with pseudoparaphyses or more rarely periphyses.

Certain of the genera that Barr (1987b) had included in the Dacampiaceae are obviously misplaced in either that family or the Teichosporaceae, and their redisposition is essential. *Eudarluca* Speg. is questionably assigned to the Phaeosphaeriaceae (Eriksson 1992. Hawksworth et al. 1995, Eriksson and Hawksworth 1998, Eriksson 1999, Kirk et al. 2001). *Leptospora* Rabenh. is tentatively assigned to the Massarinaceae Munk 1956, although the genus is included under Dothideales inc. sed. in Hawksworth et al. (1995), Eriksson and Hawksworth (1998), Eriksson (1999), and Kirk et al. (2001).

Although some species of *Massariosphaeria* (E. Müll.) Crivelli form ascomata quite similarly shaped to the obpyriform ones in members of the Teichosporaceae and have been included under *Chaetomastia* (Sacc.) Berl. (Barr 1989), they were arranged under the Lophiostomataceae Nits. 1869 (Hawksworth et al. 1995, Eriksson 1999), and when this family is separated from the Massarinaceae (Barr in prep.), the species of *Massariosphaeria* would belong in the Massarinaceae.

Ohleria Fuckel shares affinities with *Byssolophis* Clem.; both genera appear to belong in the Melanommataceae G. Wint. 1885 (Melanommatales), as Hawksworth et al. (1995), Eriksson (1999), and Kirk et al. (2001) have done for *Ohleria*, although Hawksworth et al. (1995) misplaced *Byssolophis* to the Cucurbitariaceae, and Kirk et al. (2001) to the Lophiostomataceae. Two recently described nonlichenized genera, *Aaosphaeria* Aptroot and *Munkovalsaria* Aptroot, have been assigned to the Dacampiaceae (Aptroot 1995, Eriksson 1999). Hawksworth et al. (1995) did so for *Munkovalsaria*, but left *Aaosphaeria* in Dothideales inc. sed. Kirk et al. (2001) assigned *Aaosphaeria* to Pleosporales, and *Munkovalsaria* to ?Dacampiaceae. My acquaintance with these mostly tropical genera is so limited that I have been unable to form an opinion on their disposition.

KEY TO GENERA OF TEICHOSPORACEAE

1. Amerosporous....................................2
1. Ascospores septate..............................3
    2. Ascospores hyaline in multispored asci; usually few locules formed in small stromata.......*Moristroma*
    2. Ascospores brown in four to eight-spored asci; ascomata usually separate or closely gregarious...... *Loculohypoxylon*
3. Didymosporous...................................4
3. Phragmo- or dictyosporous.......................5
    4. Ascospores hyaline..................*Sinodidymella*
    4. Ascospores brown.......................*Immotthia*
5. Dictyosporous, ascospores brown............*Teichospora*
5. Phragmosporous..................................6
    6. Ascospores narrowly fusoid, hyaline or light brown in age...........................*Bertiella*
    6. Ascospores widely ellipsoid fusoid, shades of brown..7
7. Ascospores versicolorous with dark mid cells and shorter, pallid end cells...................*Byssothecium*
7. Ascospores evenly pigmented, end cells nearly equal to mid cells.................................*Chaetomastia*

NOTES ON THE GENERA OF TEICHOSPORACEAE

Bertiella (Sacc.) Sacc. & P. Syd. 1899 was reduced to synonymy under *Massarina* Sacc. by Eriksson and Yue (1986), and that disposition was accepted by Hawksworth et al. (1995), Aptroot (1998), amd Kirk et al. (2001). The two known species differ from those in *Massarina* especially in habitat on old wood or periderm, the presence of a three-layered peridium, and absence of clypeal structures. The genus is lectotypified by *B. macrospora* (Sacc.) Sacc. & P. Syd. (Clements and Shear 1931). Nannfeldt (1975) noted that this fungus is bitunicate, although it was originally described under *Bertia* De Not., a genus in the Sordariales, Nitschkiaceae (Fitzp.) Nannf. 1932.

Ascospore sizes aid to separate two species, as does the presence of reddened ascoma apices in one of them. *Bertiella macrospora* (Figs. j, k) is known from Europe; a collection on *Salix* from Norway (*G. Mathiassen 5152b*) is a recent example of this species. Ascomata are erumpent, obtuse above; the peridium is thickened in the upper regions. The clavate asci (100-150 x 18-21 µm) in narrow pseudoparaphyses contain eight ascospores. The ascospores are hyaline and uniseptate when young; in age they develop one to four additional septa and become light brown with foveolate walls. The ascospores from the Norwegian collection measured 36-50 x 8-12 µm, comparable to those described and illustrated by Eriksson and Yue (1986) from the type specimen as 37-43 x 8-9 µm. The second species *Bertiella rhodospila* (Berk. & M.A. Curtis) M.E. Barr (Barr et al. 1986) has smaller measurements and the apical region is typically reddened. It is widespread in eastern North America on various woody substrates. I have examined an Austrian specimen (*W. Jaklitsch 1267*), and would not be surprised to find that the species occurs elsewhere in Europe. Synonymous names are known: *Sphaeria rhodospila* Berk. & M.A. Curtis 1876; *Herpotrichia rhodospila* (Berk. & M.A. Curtis) Sacc. 1883; *Metasphaeria rubida* Ellis & Everh. 1891, *Melogramma effusum* Peck 1894, and *Melanomma nigricans* Ellis & Everh. 1895. This species has smaller asci, (50-)60-95 x 8-13 µm, and ascospores, 16-25 x 3-5 µm, than does *B. macrospora*, and uni- becoming triseptate ascospores.

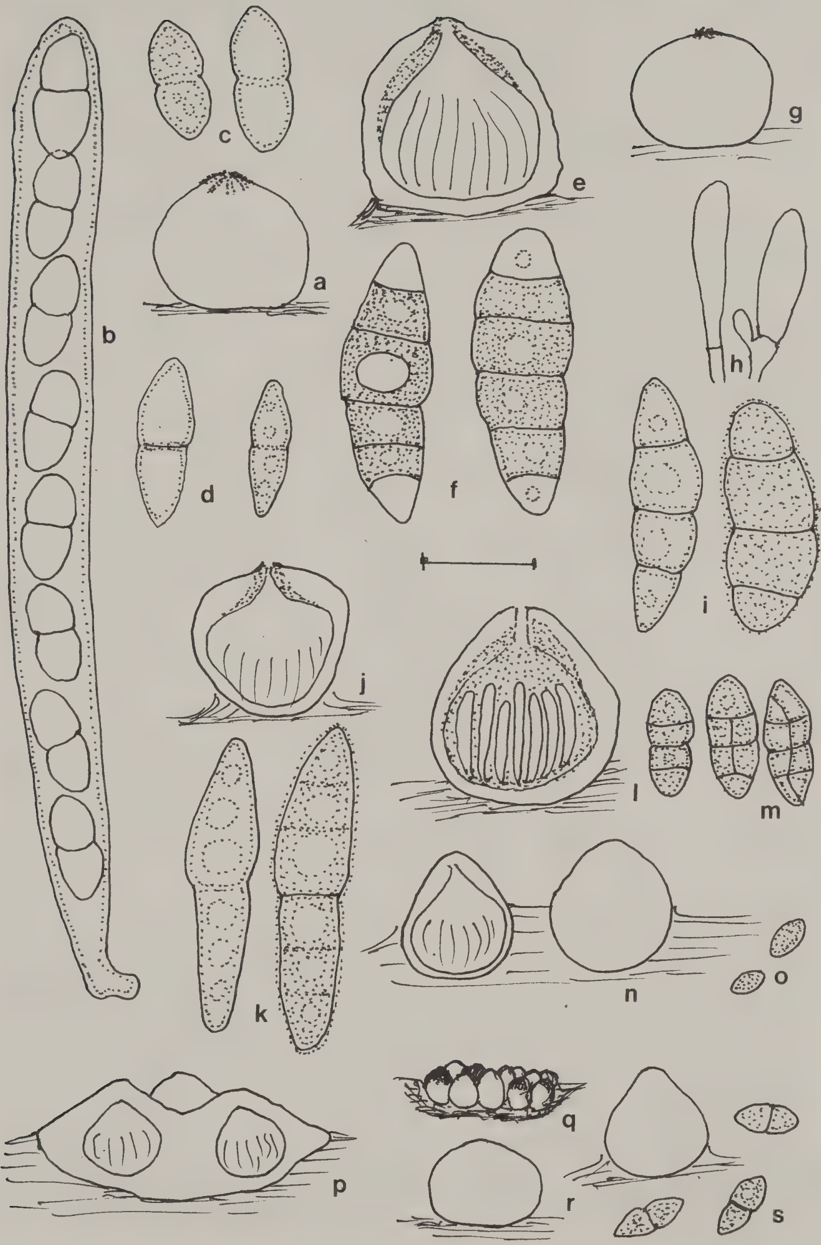
Byssothecium Fuckel 1861, with type species *B. circinans* Fuckel was reinstated by Boise (1983) for a fungus that inhabits rhizomes of *Medicago sativa* L. An anamorph produced in culture formed conidiomata referrable to *Chaetophoma* Cooke except that phialides are lageniform rather than ampulliform. Boise unravelled the problem that led Holm (1957) to recognize this fungus as *Trematosphaeria circinans* Sacc. [synonym *Leptosphaeria circinans* (Sacc.) G. Wint.] i.e., the belief that Fuckel had a conidial rather than ascomycetous fungus.

Berlese (1892, p. 88) had not recognized *B. circinans*, but noted in his disposition of the species that he excluded from *Leptosphaeria* Ces. & De Not. "L. circinans (Fuck.) Sacc. Non vidi sed a diagnosi ad Passeriniellam adscribenda." As an aside: Berlese described *Passariniella* at this time, to include two species forming versicolorous phragmospores. He indicated (p. 88): "L. dichroa Pass. est novi generis (Passeriniella) typus," and "L. incarcerata (B. et C.) Sacc. est Passariniella." Clements and Shear (1931) accepted *P. dichroa* as lectotype species and designated the genus as a synonym of *Leptosphaeria*. Berlese supposedly illustrated both species, but for *P. incarcerata* the illustration instead depicted *Leptosphaeria discors* Sacc. & Ellis, a second fungus on the type material. The species that was originally described as *Sphaeria incarcerata* forms immersed ascomata with a small elongate opening and hyaline, five-septate ascospores (Shoemaker 1984, Kohlmeyer and Volkmann-Kohlmeyer 1991). Kohlmeyer and Volkmann-Kohlmeyer were unable to locate any material of *P. dichroa* and because they could not characterize the species from Berlese's diagnosis and illustrations, they considered it a *nomen dubium*, and proposed to lectotypify *Passariniella* by *P. incarcerata* (Berk. & M.A. Curtis) Berl. As a presumed lophiostomataceous genus, *Passariniella* would then fall into synonymy under *Lophiostoma* Ces. & De Not. Alternatively, the genus name could remain in limbo until *P. dichroa* (Pass.) Berl., on branches of *Deutzia* Thunb. in Italy, is rediscovered amd investigated.

The disposition of *Leptosphaeria discors* may be resolved by the transfer of that species to *Byssothecium*, under the earlier name *Pleospora obiones* P. Crouan & H. Crouan 1867 (description in Gessner and Kohlmeyer 1976, Shoemaker 1984) . The species has the attributes of the genus, including versicolorous ascospores. Hyde and Mouzouras (1988) provided synonymy for the species when they transferred it to *Passariniella*. Khashnobish and Shearer (1996a) recently illustrated the species, and Khashnobish and Shearer (1996b) utilized molecular information to show that *P. obiones* was indeed quite different from the species of *Leptosphaeria* and *Phaeosphaeria* I. Miyake that they investigated. The combination ***Byssothecium obiones*** (P. Crouan & H. Crouan) M.E. Barr, comb. nov. is proposed (basionym: *Pleospora obiones* P. Crouan & H. Crouan, Florule du Finistere, Paris 22. 1867). Hyde and Mouzouras included another taxon, *P. savoryellopsis* Hyde & Mouzouras, that differs in hamathecium, asci, and basically uniseptate ascospores that have short, hyaline, terminal papillae. This species is not congeneric with *B. obiones* (Kohlmeyer & Volkmann-Kohlmeyer 1991).

Boise (1989) transferred a larger-spored taxon to the genus as *Byssothecium alpestris* (Tóth) Boise. Another species, *B. flumineum* J.L. Crane, Shearer & Huhndorf (Crane, Shearer and Huhndorf 1992) was described from submerged wood. The ascospores form four nearly equal cells that are differentially pigmented. The ostiole is periphysate. The authors presented information on developmental stages of the species. Although three-septate ascospores are typical for the genus, another taxon produces mostly five-septate ascospores and is described below. The species now recognized as members

Figure 1. Teichosporaceae. a-c. *Sinodidymella americana*: a, ascoma in outline, b, ascus, c, ascospores. d. *S. hesperia*, ascospores. e, f. *Byssothecium cholla*: e, ascoma in section, f, ascospores. g-i. *Chaetomastia cactorum*: g, ascoma in outline, h, inflated hyphae from apical papilla, i, ascospores. j, k. *Bertiella macrospora*: j, ascoma in section, k, ascospores. l, m. *Teichospora trabicola*: l, ascoma in section, m, ascospores. n, o. *Loculohypoxylon grandineum*: n, ascomata in section and in outline, o, ascospores. p. *Moristroma polyspora*, stroma and locules. q-s. *Immotthia atrograna*: q, habit of grouped ascomata and pycnidia, r, ascomata in outline, s, ascospores. Standard line = 15 µm for ascus, ascospores, and inflated hyphae; 150 µm for ascomata; q not to scale.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of *Byssothecium* may be separated by the following key.

1. Ascospores mostly 5-septate, 25-35 x 10-13 µm.......... *B. cholla*
1. Ascospores 3-septate..................................2
    2. Ascospores 24-30(-33) x 7-10 µm.......*B. flumineum*
    2. Ascospores (8-)10-12-15 µm wide.................3
3. Ascospores 36-42(-45) µm long.............*B. alpestris*
3. Ascospores 23-33(-38) µm long.........................4
    4. In roots of *Medicago*, cultivated fields.......... *B. circinans*
    4. In seaside plants.....................*B. obiones*

Byssothecium cholla M.E. Barr, sp. nov. Figs. e, f

Ascomata perithecioidea obovoidea 440-660 µm erumpentia. Asci bitunicati 120-180 x 15-20 µm in pseudoparaphysibus cellulosis. Ascosporae 25-35 x 10-13 µm ellipsoideae fusoideae castaneae (3-4-)5(-6-) septatae, cellulae terminales pallidae. Holotypus in ligno nudo *Opuntiae fulgidae* Engelm. "USA. Arizona: Saguarro Nat'l Monument, 29 Jul 1980" a R.L. Gilbertson lectus, in NY depositus sub *M.E. Barr 6767*; paratypus a R.L. Gilbertson lectus, in NY depositus sub *M.E. Barr 6768*.

Ascomata perithecioid, separate or two to three grouped and united laterally, erumpent superficial; surface black, irregular with protruding cells and short hyphae; short obovoid, 440-660 µm; apex rounded, papilla short; peridium wide, externally heavily pigmented, dark reddish brown, outer and mid layers 65-80 µm wide, up to 100 µm toward apex, ca. 40 µm at base, innermost layer of pallid compressed rows of cells. Asci 120-180 x 15-20 µm, cylindric; pseudoparaphyses narrowly cellular. Ascospores 25-35 x 10-13 µm, mid cells dark reddish brown, end cells short and pallid, ellipsoid fusoid, (3-4-)5(-6-) septate, constricted at septa; wall smooth or foveolate; one globule per cell; uniseriate or partially biseriate in the ascus.

Known from the type collections. 'Cholla' is a colloquial name for this species of cactus.

Chaetomastia (Sacc.) Berl. 1891 is lectotypified by *C. hirtula* (P.Karst.) Berl. (Clements and Shear 1931). Barr (1989) summarized the history of the genus and suggested that most of the species Berlese had included probably belonged in *Capronia* Sacc. (Herpotrichiellaceae Munk 1953, Chaetothyriales M.E. Barr 1987). The 'chaeto' part of the name is somewhat of a misnomer, for while the type species bears some hyphal appendages, these are neither abundant nor are they true setae.

Leuchtmann (1984) submerged *C. hirtula* under *Montagnula* Berl. when he assigned three phragmosporous taxa to that genus. Barr (1989) included the supposedly synonymous name *Massariosphaeria* (E. Müll.) Crivelli, and at that time incorporated several other species that do not belong in the genus, and are now assigned elsewhere. Hawksworth et al. (1995) amd Kirk et al. (2001) list *Chaetomastia* under Ascomycota, Genera inc. sed., whereas Eriksson and Hawksworth (1986, 1998) had it assigned as Unitunicate Ascomycetes, inc. sed., and Eriksson (1999) as Sordariomycetes: Genera of uncertain position. The asci of *C. hirtula* are obviously bitunicate with fissitunicate opening, as Holm (1957) had recognized.

Chaetomastia equiseti M.E. Barr (Barr 1989) is difficult to reassign. The species is surely identical with *Phaeosphaeria celata* Shoemaker & E.C. Babc., described later in the same year (Shoemaker and Babcock 1989). These authors realized that the taxon differed from species of *Phaeosphaeria* found on horsetails, but could not suggest a better position for it. The peridium of ascomata is narrow and the apical region slightly clypeate; the symmetric, yellowish-brown ascospores with darker constricted septa, pallid end cells, and wide, umbilicate gel coating suggest a relationship to *Amarenomyces ammophila* (Lasch) O. Erikss. (Eriksson 1981), as do the asci with a wide endotunica. These taxa, and *Hadrospora fallax* (Mouton) Boise (Boise 1989), may be related, although their familial position is difficult to determine and they are only tentatively disposed in the Phaeosphaeriaceae.

From Barr's (1989) treatment, only two species are retained in *Chaetomastia*, *C. hirtula* and *C. sambuci* (Earle) M.E. Barr. Two species have been added since, *C. littoralis* M.E. Barr (Barr 1993b), and *C. scelesta* (Cooke & Ellis) M.E. Barr (Barr 1993a). One additional species is transferred to the genus with a modern description. The following is a revised key to species.

1. Ascospores (3-)5-7-septate, 21-26(-29) x 7-8 µm; ascomata ellipsoid, opening by long slit.......*C. scelesta*
1. Ascospores 3-septate; ascomata obpyriform with papilla containing rounded ostiole..................................2
    2. Asci four-spored; ascospores 17-25.5 x 6.5-9.5 µm. *C. hirtula*
    2. Asci six- or eight-spored.........................3
3. Often six to eight ascospores maturing, (14-)18-25 x 6-7.5 µm...*C. sambuci*
3. Usually eight ascospores maturing, 7-10 µm wide.......4
    4. Ascoma apex composed of short inflated cells; ascospores (14.5-)18-23(-25) µm long......*C. cactorum*
    4. Ascoma apex not composed of inflated cells; ascospores 16-23(24) µm long................*C. littoralis*

Chaetomastia cactorum (Earle) M.E. Barr & Boise, comb.nov. Figs. g-i

Basionym: *Trematosphaeria cactorum* Earle, Bull. New York Bot. Gard. 2: 347. 1902.

Ascomata separate or gregarious, occasionally two united, erumpent superficial, obovoid or globose, 300-500 µm diam; apex rounded, slightly tapered, papilla usually composed of short, inflated cells; surface smooth or roughened by protruding cells; peridium dark brown, rugulose and heavily pigmented externally, mid layers of scleroplectenchymatous cells, up to 60 µm wide, inner layer of compressed rows of pallid cells. Asci 100-140 x 10-14 µm; pseudoparaphyses narrowly cellular. Ascospores (14.5-)18-23(-25) x 7-10 µm, golden to dark brown, ellipsoid fusoid, (1-)3-septate, constricted; wall verruculose; one globule per cell; uniseriate in the ascus.

On members of the Cactaceae. USA. California: on old spines of *Cereus* sp., Santa Clara Co., Stanford Univ., 26 Oct 1901, *C.F. Baker Pacific Slope Fungi 1* (NY, Holotype). Mexico. Intercepted by customs: at San Francisco, CA *14719* on *Echinocactus* sp., 29 Apr 1938, *W.H. Wheeler* (BPI); at Laredo, TX *58444* on *Ferocactus* sp., 4 Mar 1958, *A.H. Lewis* (BPI); at Brownsville, TX *08834* on *Astrophytum ornatum* (DC.) Britton & J. Rose, 15 Jan 1979, *J.M. Van Valkenburgh* (BPI); at Brownsville, TX *009147* on *Myrtillocactus geometrizans* (Mart. ex Pfieff.) Console, 24 Apr 1979, *J.M. Van Valkenburgh* (BPI).

The description and other information are courtesy of Jean Boise, who made available to me a copy of her notes on this species. In her dissertation (Boise 1984) she tentatively and with reservations assigned the fungus to *Stuartella* Fabre, a genus that now seems best disposed in the Cucurbitariaceae.

Immotthia M.E. Barr 1987 was described to accommodate a small to medium-sized, didymosporous taxon, *I. hypoxylon* (Ellis & Everh.) M.E. Barr, that develops over stromata of species in *Hypoxylon*, but may also form on a compressed stromatic layer on old wood or periderm (presumably remnants of the stroma). This species is widely dispersed in north temperate regions, known from North America, Europe, and in Asia from NW China. The globose to obpyriform ascomata vary in amount of basal tissues formed (Figs. q-s). The cylindric-oblong asci contain brown didymospores that are quite consistent in size, 9-15(-16) x 4.5-6(-7) µm. The ascomata are frequently associated with conidiomata that produce light brown, one-celled conidia, described as *Coniothyrium parasitans* (Berk. & Ravenel) Tassi. Because of the superficial habit of the fungus, Hansford (1946) suggested and Petrak (1957) made the transfer of the teleomorph to *Dimerium* (Sacc. & P. Syd.) Sacc. & D. Sacc. and the anamorph to *Cicinnobella* Henn. The discrepancies between the present fungus and any dimeriaceous taxon make such disposition quite unlikely. Barr (1987a) utilized the commonly used name in making the transfer to *Immotthia* as *I. hypoxylon* for *Amphisphaeria hypoxylon* Ellis & Everh. 1886, but there exist earlier epithets. Barr (1993a) proposed the combination *I. atrograna* (Cooke & Ellis) M.E. Barr for *Sphaeria atrograna* Cooke & Ellis 1879, the earliest name presently confirmed. She included the synonymous names *Amphisphaeria deformata* Ellis & Langl. 1888, *A. pilosella* Ellis & Everh. 1895, and *A. confertissima* Ellis & Everh. 1895, and should also have specified *A. hypoxylon* as another synonym. Ju and Rogers (1995) indicated that *Sphaeria insidens* Schwein.: Fr. 1823 was identical, but Scheuer (pers. comm.) believes that name to be a *nomen dubium*, because the protologue could refer to either the *Immotthia* or the presumed anamorph, and the holotype in PH contains only the presumed anamorph.

A second species is represented by *Didymosphaeria atroseptata* Piroz., (Pirozynski 1973) in the hymenium of *Pestalopezia rhododendri* Seaver, on leaves of *Rhododendron maximum* L, in North Carolina, USA. Previously I had tentatively referred the species to *Byssosphaeria* Cooke (Barr, pers. comm. in Aptroot 1995). The basally arranged asci develop in obovoid ascomata; the peridium is thickened apically, and is typical for the family. Similarities in brown ascospores (13-17 x 4-5 µm) and substrate preference lead to the proposal of ***Immotthia atroseptata*** (Piroz.) M.E. Barr comb. nov. (basionym: *Didymosphaeria atroseptata* Piroz., Mycologia 65: 731. 1973).

Loculohypoxylon M.E. Barr 1976 is a monotypic genus. The single species known is *L. grandineum* (Berk. & Ravenel) M.E. Barr (Barr 1976), in periderm of *Quercus coccinea* Munschh. or *Quercus* sp., from New Jersey, North Carolina and South Carolina in USA (Figs. n, o). The small, brown amerospores, 7.5-10(-11) x 4.5-6.5 µm, set the taxon apart. Although Hawksworth et al. (1995), Eriksson (1999) and Kirk. et al. (2001) have the genus under Dothideales inc. sed., *Loculohypoxylon* bears so many similarities in habit and habitat, ascomata, and asci to species in *Immotthia* and *Teichospora* that it must be treated with these genera in the Teichosporaceae.

Moristroma A.I. Romero & Samuels 1989 has as unique features multiple hyaline amerospores within each ascus and ascomata forming loculate areas in small stromata (Fig. p) or united on a common stromatic base. The genus is presently monotypic, with *M. polyspora* A.I. Romero & Samuels developed on wood of *Eucalyptus* L'Herit. in Argentina (Romero and Samuels 1989).

Sinodidymella J.Z. Yue & O. Erikss. 1985 was described to accommodate *S. verrucosa* (Petr.) Y.Z. Yue & O. Erikss. The authors referred the genus to Dothideales s. lat., although they considered a possible relationship with members of Massarinaceae (O. Eriksson, pers. comm.). The distinguishing morphological characteristics are the presence of radiating ridges around the apical ostiole of the ascoma, and hyaline, ellipsoid didymospores in cylindric asci. Barr (1993b) has added a second species, *S. occidentalis* M.E. Barr and suggested assigning the genus to the Dacampiaceae. Hawksworth et al. (1995), Eriksson and Hawksworth (1998), Eriksson (1999), and Kirk et al. (2001) accepted that disposition. The genus posseses the qualities that place it within the Teichosporaceae as that family is now separated from the Dacampiaceae.

The ascomata of *Sinodidymella verrucosa* bear a strong resemblance to a species that Barr (1984, 1990a) had incorrectly assigned to *Lojkania* Rehm 1905. This latter species, *Melanopsammina utahensis* Petr. 1927, according to the isotype and a second collection, has hyaline didymospores in cylindric asci and quite well marked apical radiating ridges. Although the ascomata do not reach the sizes of 1 mm noted by Yue and Eriksson (1985), they are quite large, 470-770 µm, and other characteristics are in accord. The substrate in every collection is a member of the Chenopodiaceae: *Salsola* L. for the Chinese collection, *Atriplex* L. for *M. utahensis*, and *Sarcobatus* Nees in Wied.-Neuw. for the second North American collection. Petrak's species epithet for the North American collection provides the earlier name for this species, and a new combination is proposed: ***Sinodidymella utahensis*** (Petr.) M.E. Barr, comb. nov. Basionym: *Melanopsammina utahensis* Petr. Ann. Mycol. 25: 274. 1927. Synonyms: *Lojkania utahensis* (Petr.) M.E. Barr, Mycotaxon 20: 18. 1984. *Amphididymella verrucosa* Petr., Acta Horti Gothob. 17: 129. 1947. *Sinodidymella verrucosa* (Petr.) J.Z. Yue & O. Erikss., Mycotaxon 24: 295. 1985.

The two brown-spored collections that Barr (1984, 1990a) had assigned to *Lojkania utahensis* may be arranged under *L. nuda* (Ellis & Everh.) M.E. Barr. In addition to *S. utahensis* several species with smaller-sized ascomata form somewhat less conspicuous, radiating or verrucose apices to ascomata, and hyaline didymospores in cylindric asci. Two undescribed species are added to the genus; the following key to species is based especially on ascospore sizes.

1. Ascomata large, 475-770 µm or up to 1 mm wide, in stems of chenopods; ascospores 16-21(-23) x 7.5-10 µm.......... *S. utahensis*

1. Ascomata medium sized, 275-450(-600) µm wide; on wood or periderm of trees or shrubs........................2

    2. Ascospores small, 12-15(-20) x 5-6(-7.5) µm...... *S. occidentalis*

    2. Ascospores mostly over 15 µm long...............3

3. Ascospores 15-20 x 6.5-8.5 µm, ellipsoid...*S. americana*

3. Ascospores narrower, 20-25(-30) x 5-7(-8) µm.......... *S. hesperia*

Sinodidymella americana M.E. Barr, sp. nov. Figs. a-c

Ascomata perithecioidea gregaria globosa sphaeroidea 275-495 µm lata, apices obtusi et porcati radiati. Asci bitunicati et fissitunicati 95-150 x 9-12 µm 4-6 vel 8-spori. Pseudoparaphyses cellulosae. Ascosporae 15-20 x 6.5-8.5 µm hyalinae ellipsoideae fusoideae uniseptatae uniseriatae. Holotypus in ramis *Aceris pensylvanici*, "USA, Massachusetts: Franklin Co., Florida, Mohawk Trail State Forest, 25 Sep 1970" a *M. E. Barr n. 5646* lectus, in herb. NY depositus.

Ascomata perithecioid, separate or often gregarious, at times crowded and sides connected, immersed becoming erumpent, globose sphaeroid, 275-495 µm wide, 385-440 µm high; apex bearing radiating ridges on surface, ostiole periphysate; peridium brown, outer layer of small pseudoparenchymatous cells, thickened from base to upper sides, 25-30 µm wide, heavily encrusted on surface, mid layer of hyaline or light brown pseudoparenchymatous cells, 25-30 µm wide, innermost layer narrow, cells compressed. Asci 95-150 x 9-12 µm, (4-, 6-) 8-spored; pseudoparaphyses narrowly cellular, ca. 2 um wide. Ascospores 15-20 x 6.5-8.5 µm, hyaline, ellipsoid fusoid, tapered to acute ends, 1-septate, constricted at septum; wall smooth; contents minutely guttulate; uniseriate in the ascus.

On branches of various trees and shrubs. USA. Arizona: Pima Co., Santa Catalina Mts., Bear Wallow, 2 Aug 1980, *Philadelphus* sp., *M.E. Barr 6833*. Massachusetts: Franklin Co., Conway, Baptist Hill, 16 Dec 1979, *Fraxinus americana* L., *M.E. Barr 6644*. Michigan: Emmet Co., Burt Lake, Colonial Point, 10 Sep 1960, *Fagus grandifolia* Ehrh., *M.E. Barr 5512c*. Ohio: Jefferson Co., Jefferson Lake State Park, 26 Jul 1973, *Fraxinus americana*, *W.B. & V.G. Cooke 47948* part (all NY).

It is a especially pleasing finally to find a suitable position for this species. Collections have puzzled me for years, until I recognized the nature of the peridium and the presence of rather subtle radiating ridges on the ascomata.

Sinodidymella hesperia M.E. Barr, sp. nov. Fig. d

Ascomata perithecioidea superficialia globosa sphaeroidea vel 600 µm lata 440-495 µm alta, apices verrucosa. Asci bitunicati et fissitunicati 120-135 x 10-12 µm. Pseudoparaphyses cellulosae. Ascosporae 20-25 (-30) x 5-6(-8) µm hyalinae ellipsoidae fusoideae uniseptatae et constrictae. Holotypus in ramulis *Eucalypti*, "USA. California: San Francisco, Jun" a *H.W. Harkness* lectus in herb. NY depositus sub *Eriosphaeria investans* Cooke.

Ascomata perithecioid, separate to gregarious, superficial with bases attached firmly, globose sphaeroid, up to 600 µm wide, 440-495 µm high, apex rounded, roughened verrucose around apical pore; peridium externally dark reddish brown, pseudoparenchymatous cells heavily encrusted with pigment on surface, 50-80 µm wide, mid layer 15-30 µm, light brown to pallid pseudoparenchymatous cells, innermost layer narrow, small compressed cells;

surface dull black, often roughened by sand grains and debris. Asci 120-135 x 10-12 µm; pseudoparaphyses narrowly cellular. Ascospores 20-25(-30) x 5-6(-8) µm, hyaline, light brownish after discharge from asci, ellipsoid fusoid, 1-septate, constricted at septum; wall smooth; contents refractive or two globules per cell; uniseriate in the ascus.

Additional material: Canada. British Columbia: *Acer macrophyllum* Pursh, Sidney, 2 May 1994, *M.E. Barr 8744*, Sidney, 24 Feb 1997, *M.E. Barr 9341*. *Amelanchier alnifolia* (Nutt.) Nutt., all Sidney: 21 Feb 1998, *M.E. Barr 9616*, 22 Mar 1998, *M.E. Barr 9650*, 31 Jul 1998, *M.E. Barr 9722*, 10 Apr 1999, *M.E. Barr 9923* (all DAOM).

The California specimen chosen as holotype had been determined as *Eriosphaeria investans* (Cooke) Sacc. That species was described from England, with ascomata in brown subiculum and lanceolate ascospores 20-23 µm long. It seems most unlikely to be identical with these specimens.

Teichospora Fuckel 1870 was investigated and a key to species provided (Barr 1990b). Oddly enough, the genus is designated only as Dothideales inc. sed. by Hawksworth et al. (1995), Eriksson and Hawksworth (1998), Eriksson (1999), and Kirk et al. (2001). There is no note on the genus in the various issues of Systema Ascomycetum. Arx and Müller (1975) had it in the Pleosporaceae, but they typified *Teichospora* by *T. obducens* (Fr.) Fuckel, a species of *Cucurbitaria* Gray (Petrak 1927, Barr 1990b), and not by *T. trabicola* Fuckel as Fuckel (1870) himself had stipulated (Barr 1987b, 1990b). The species show considerable variation in sizes and shapes of ascomata (Figs. l, m), cylindric or clavate asci, and in septation and symmetry or asymmetry of the brown dictyospores, as Barr (1990b) illustrated.

Teichospora hesperia M.E. Barr is an additional species, described from *Arbutus menziesii* Pursh in British Columbia (Barr 1993b). From NW China come some extensions of geographical distribution for *T. borealis* (Ellis & Everh.) M.E. Barr, *T. solitaria* (Ellis) Ellis & Everh., and *T. winteriana* Berl., as well as the recently described *T. lonicerae* Z.Q. Yuan & M.E. Barr (Yuan and Barr 1995). One species that Barr (1990b) had reduced to synonymy under *T. clavispora* Ellis & Everh., namely *Lophidium pachystomum* Ellis & Everh., must be removed and reinstated in the Lophiostomataceae, which is again recognized as a family belonging in the Melanommatales (Barr and Huhndorf 2000).

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PHYTOPHTHORA CINNAMOMI VAR. ROBINIAE VAR. NOVA ON BLACK LOCUST IN JIANGSU PROVINCE OF CHINA

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ABSTRACT

The dominant pathogen causing stem rot or bark canker of black locust trees (*Robinia pseudoacacia*) in Jiangsu Province of China, previously identified as *Phytophthora cinnamomi*, *P. cinnamomi* atypical forms, *P. richardiae* and *P. robinicola* is now renamed *P. cinnamomi* var. *robiniae* var. nov.

Keywords: Oomycetes, stramenopilous fungi, Pythiaceae, *Robinia pseudoacacia*

In 1981 the death of many black locust trees (*Robinia pseudoacacia* L.) in Jiangsu Province, China was first noted to be due to stem rot or bark canker (Huang and Wang, 1981). The casual agent was isolated and identified as *P. cinnamomi* Rands (Zhuang, 1981; Huang and Wang, 1983). In 1982 I examined the isolates studied by them at the Academia Sinica, Beijing. Although they were similar to *P. cinnamomi,* they differed from the known isolates of the species (Zentmyer, 1980) because of the absence of chlamydospores and the production of small, spherical, catenulate hyphal swellings. Subsequently, they were identified as atypical forms of *P. cinnamomi* (Ho et al., 1983). Later, another new isolate similar to those above was named by Li (1985) and Li and Yu (1987) as *P. richardiae* Buisman. Xu et al. (1990) in a comprehensive study of the disease on black locust obtained 56 isolates, 11 of which were identified as *P. nicotianae* Breda de Haan, 9 as *P. drechsleri* Tucker and 36 as *P. robinicola* Lu, Xu and Fang sp. nov., (Xu et al., 1990) which was the dominant pathogen.

In the summers of 1992 and 1993 I examined six new isolates from diseased black locust trees at Nanjing Agriculture University, but unfortunately, the isolates previously designated as *P. richardiae* (Li, 1985 ; Li and Yu, 1993) and *P. robinicola* (Xu et al., 1990) were no longer in existence. Nevertheless, based on the descriptions cited above, there was little doubt that all isolates from black locust, previously identified as *P. cinnamomi, P cinnamomi* atypical forms, *P. richardiae* and *P. robinicola* had similar characteristics and should be assigned to the same taxon.

Li (1985) identified the black locust pathogen as *P. richardiae* primarily based on the short antheridial hyphal outgrowth. However, such finger-like appendages characteristic of subterminal antheridia are also found in other species of *Phytophthora* (Stamps et al., 1990). The high minimum (16°C) and high maximum (36°C) growth temperatures and the entirely amphigynous antheridia differ significantly from the low minimum (3-4°C) and low maximum (32°C) growth temperatures and the presence of both paragynous and amphigynous antheridia, characteristic of *P richardiae* (Waterhouse, 1963). This species has extremely narrow host range, causing primarily root rot of calla lily (Hall, 1991; Erwin and Ribeiro, 1996). It is clear that the identification of the black locust pathogen as *P. richardiae* is questionable based on biological and pathological criteria.

Although Xu et al. (1990) considered the dominant pathogen of black locust trees to be distinct enough to warrant a new species epithet, the binomial *P. robinicola* was not validly published for lack of a Latin diagnosis and failure to cite a type specimen. To me all these isolates from black locust appear to be morphologically too similar to *P. cinnamomi* to justify the erection of a new species name, even though electrophoresis of soluble proteins and esterase from mycelia showed that they have a slightly different pattern from the typical isolates of *P. cinnamomi* (Li, 1985; Xu et al., 1993). Thus the erection of the new variety proposed (*P. cinnamomi* var. *robiniae* var. nov.) for the isolates from black locust, previously identified as *P. cinnamomi, P. cinnamomi* atypical forms, *P. robinicola,* and *P. richardiae* is warranted. It differs from both *P. cinnamomi* var. *cinnamomi* and *P. cinnamomi* var. *parvispora* Kröber and Marwitz (1993) because of the absence of chlamydospores. A new description is hereby provided.

Phytophthora cinnamomi* var. *robiniae H.H.Ho **var. nov.** Figs. 1-4
= *Phytophthora cinnamomi* H..H. Ho, W.Y. Zhang, Z.R. Liang & Y.N. Yu Mycologia. 15:883. 1983
= P*hytophthora richardiae* J.L. Li & Y.N. Yu. 2nd. Nat. Symp. Fungi & Lichens Abstr.: 53. Wuchang 1987
= *Phytophthora robinicola* J.Y. Lu, J.Y. Xu & F.D. Fang. Nanjing Agr. Univ.:19 1990

Mycelium hyalinum ramosum laevitunicatum aseptatum vel aetate septis instructum, 5-7 mm latum, saepe irregulariter turgescens, corollaceum atque aggregatum. Ganglia hyphalia sphaerica vel ovalia usque 35 µm diamtero, catenulata vel reticulata, vel irregularia usque tantum 15 um diametro atque hyphis radialibus instructa. Sphorangiophora saepe aliquot per ganglium hyphalis exorientia, angusta, 1-3 mm lata, haud distincta, simplicia, interne prolificantia vel laxe sympodialiter ramosa. Sporangia terminalia non decidua hyalina ovoidea vel in aqua obpyriformia, (30-) 40-70 (-83) x (18-) 24-41 (-47) µm, ratione arithmetica longitudinis usque latitudinis (1.2-) 1.3-2.0 (-2.5). Oogonia globosae brunnea, (25-) 30-43 (-54) µm. Oosporae unicae globosae hyalinae, (26-) 28-37 (-40) µm, parietibus 2-5 um crassis praeditae. Antheridia amphigyna cylindracea, (10-) 13-19 (-25) x (12-) 13-16 (-21) µm, unicellularia vel interdum bicellularia. Chlamydosporae non visae. Temperaturea cardinals 5-8, 28-32, 36-37 C.

Habitat in caule *Robinae pseudoacacia* L. Cariem caulis vel corticis efficiens.

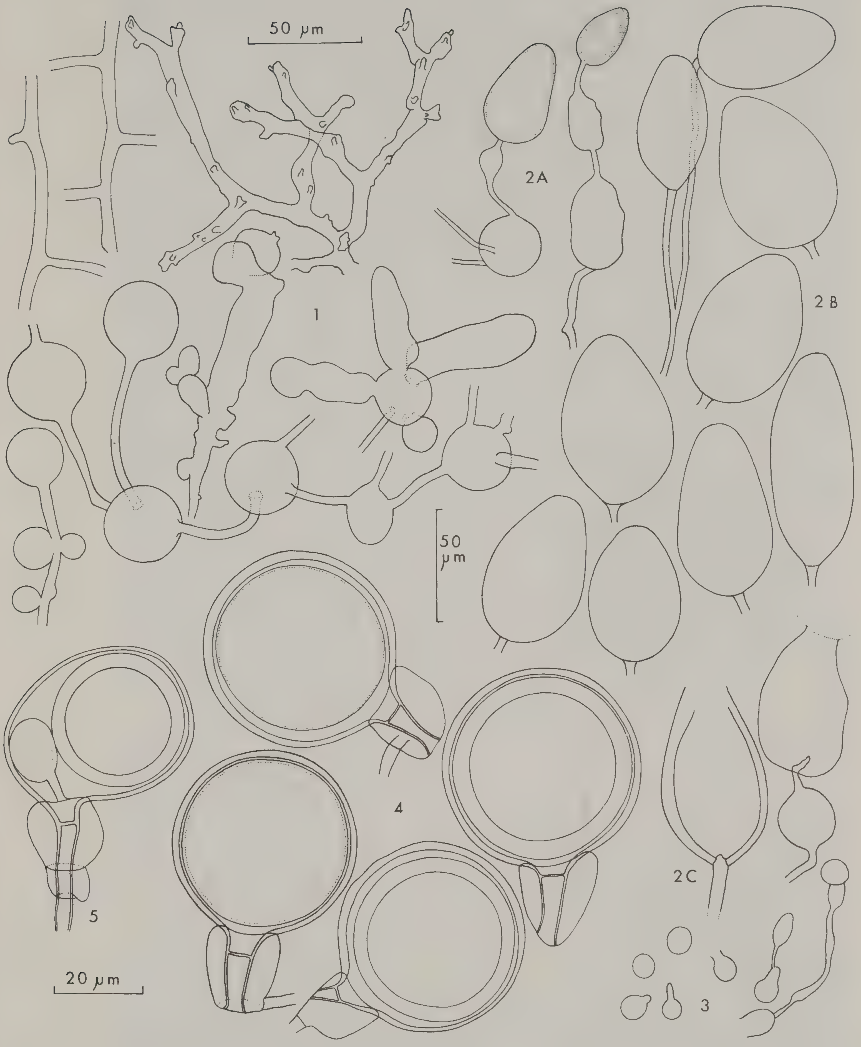

Fig. 1. *Phytophthora cinnamomi* var. *robinae.* (1) Hyphae and hyphal swellings. (2) Non-papillate sporangia (A,B) and sporangial proliferation (C). (3) Cysts, empty cysts and microsporangia. (4) Oogonia, oospores and amphigynous antheridia. (5) Bicellular antheridium

Fungal colony on clarified V8 juice agar moderately fluffy, without a distinct growth pattern. Mycelium hyaline, freely branched, smooth-walled, nonseptate or septate with age, 5-7 µm wide, often becoming irregularly inflated, coralloid and clustered (Fig. 2). Hyphal swellings spherical to oval, under 35 µm diam, catenulate to reticulate, or irregular under 15 µm diam, with radiating hyphae (Fig. 1-1). Sporangiophores often clustered arising from a small hyphal swelling, narrow, 1-3 µm wide, undifferentiated, unbranched, internally proliferating or lax sympodially branched. Sporangia produced sparsely on agar medium but abundantly in water (Fig. 3), terminal, non-deciduous, hyaline, ovoid or obpyriform in water (30-) 40-70 (-83) x (18-) 24-41 (-41) µm, length/breadth ratio (1.2-)1.3-2.0 (-2.5). Zoospores 14-16 x 10-12 µm ; cysts 12 µm diam. Repeated emergence of zoospores observed. Cysts sometimes germinate by the production of microsporangia . Heterothallic but occasionally self-fertile. Oogonia globose or pyriform (Fig. 4), smooth-walled, light brown, (25-) 30-43 (-54) µm diam. Oospores single, globose, hyaline, (26-) 28-37 (-40) µm diam, wall 2-5 µm thick. Antherida amphigynous , cylindrical, (10-) 13-19 (-25) x (12-) 13-16 (-21) µm, unicellular but sometimes bicellular. Chlamdospores not observed. Cardinal temperature 5-8, 28-32, 36-37° C.

HOLOTYPE. CHINA, JIANGSU PROVINCE: P31 from black locust trees with stem rot or bark canker, 1980; deposited as glass slide mounts at the Department of Biology, SUNY New Paltz. Ex-type culture: ATCC 56194.

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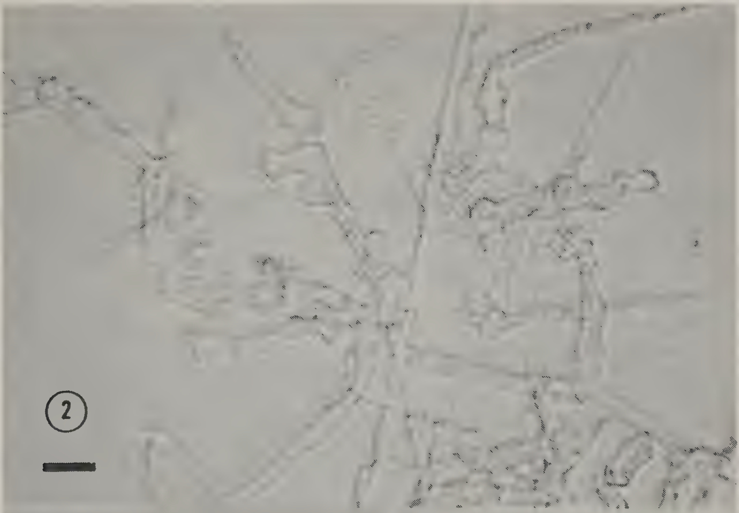
Fig. 2-4. *Phytophthora cinnamomi* var. *robiniae.* (2) Coralloid hyphae (3) Proliferating sporangia, (3,4) Oogonia, oospores and amphigynous antheridia. Scale bar = 10µm. All at same magnification except (2) where scale bar = 50 µm.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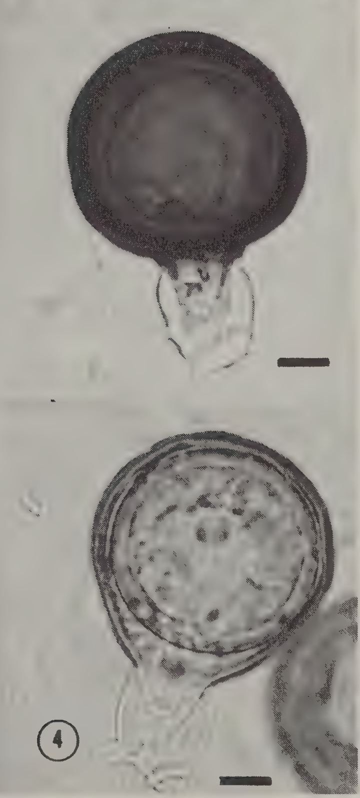
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THREE NEW PSEUDOCERCOSPORA SPECIES, ONE WITH A MYCOSPHAERELLA TELEOMORPH, FROM KENNEDIA IN AUSTRALIA

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Abstract: *Pseudocercospora kennediicola* sp. nov., *P. warcupii* sp. nov. and *P. hopetounensis* sp. nov. are described from leaf spots on *Kennedia prostrata, K. nigricans* and *K. rubicunda* respectively. *P. warcupii,* which has an intimately associated *Mycosphaerella* teleomorph, displays an unusual combination of characters: hyaline conidia, inconspicuous scars and hyaline to pale conidiogenous cells which are generated, in some instances enteroblastically, from the outermost cells of conspicuous brown stromata. The three new species are compared with *P. kennediae*, a previously described foliar pathogen from *Kennedia prostrata*, and a key to species is provided.

Key words: Fabaceae, proliferation, taxonomy

The genus *Kennedia* Vent. (Fabaceae) is endemic to Australia, and includes 16 species of perennial trailing or prostrate herbs or sub-shrubs with showy flowers which may be red, purplish, blue, violet or almost black (Jeanes, 1996). Some species, notably *K. rubicunda* Vent., are popular cultivated plants. A study of herbarium specimens of leaf-spotting cercosporoid fungi occurring on *Kennedia* spp. in eastern Australia has resulted in the recognition of three new species of *Pseudocercospora* to be added to the previously described *P. kennediae* (Cooke & Massee) U. Braun. This paper presents descriptions and illustrations of all four species of *Pseudocercospora* known to occur on *Kennedia* spp., and a key to their identification.

Pseudocercospora kennediicola Beilharz, Pascoe & Parbery, sp. nov. (Fig. 1)

Etym.: from *Kennedia*, the host genus, and the latin *–cola* , meaning 'dweller'

Stromata amphigena, pallide brunnea, c. 38 µm diam. x 35 µm profunda (substomatalia) vel medio brunnea, 55–72 µm diam. x 29–58 µm profunda (subepidermalia). *Conidiophora* numerosa, pallide olivaceo-brunnea, cylindrica, erecta, recta vel leniter curvata, laevia, 0–3 septata, (19–)30–60(–82) μm longa x 3–5 μm lata. *Cellulae conidiogenae* laeves, ad apicem abrupte deminutae et interdum geniculatae, 13–35 x 4–5 μm. *Loci conidiogeni* 1–3, non incrassati, pallidi vel parum fuscati, non-refractivi, 1–1.75 μm diam. *Conidia* pallide brunnea, laevia, obclavata, recta vel curvata, 0–14 euseptata, non constricta, apicem obtusem versus gradatim deminuta, basim obconicam vel rostratam versus abrupte deminuta, (20–)50–130 (–260) μm x (2.25–) 2.5–5 μm. *Hila* non-incrassata, non-fuscata, non-refractiva, (0.75–) 1–1.75 (–2) μm lata.

Lesions hologenous, becoming necrotic, angular, subcircular or irregular, limited by major veins, pale brown with a darker brown margin, commonly 2–5 mm diam., larger when confluent. *Immersed mycelium* very pale brown, branched, septate, intercellular, 1.75–2.5 μm diam. *Superficial mycelium* emerging from the stomata, pale brown, smooth, septate, branching, patent, anastomosing, 2.25–3 μm diam., bearing lateral conidiophores 0-1 septate, 32-38 μm long x c. 3 μm wide, showing 0–2 percurrent enteroblastic proliferations. *Stromata* substomatal or subepidermal on the abaxial leaf surface, subepidermal on the adaxial surface (which lacked stomata), discrete, composed of *textura angularis*. *Substomatal stromata* light brown, c. 38 μm wide x 35 μm deep, becoming erumpent. *Subepidermal stromata* medium brown, scattered, compact, erumpent, 55–72 μm wide x 29–58 μm deep. *Conidiophores* numerous, pale olivaceous brown, cylindrical, erect, straight or slightly curved, 0-2 septate, (19–)30–60(–82) μm long x 3–5 μm diam. *Conidiogenous cells* integrated, terminal, smooth, pale brown, becoming paler and sometimes geniculate towards the apices, 13–35 x 4–5 μm. *Conidiogenous loci* 1–3, unthickened, pale or slightly darkened, formed in association with enteroblastic sympodial or pseudopercurrent proliferations of the conidiogenous cell, 1–1.75 μm diam. *Conidia* holoblastic, pale brown, smooth, obclavate, straight or curved, 0–14 euseptate, not constricted at the septa, eguttulate, tapered gradually to an obtuse apex and more abruptly to an obconic or rostrate base, (20–)50–130(–260) μm long x (2.25–)2.5–5 μm wide. Hila pale, unthickened, non-protuberant, not refractive, (0.75–)1–1.75(–2) μm diam.

Holotype: **Australia**. On living leaves of *Kennedia* sp., Victoria, Healesville, Healesville Wildlife Sanctuary, *V. & R. Beilharz*, 16 Sept. 1989, VPRI 17460.

Additional specimens examined: **Victoria**: On living leaves of *Kennedia rubicunda*, Croajingalong N.P., shores of Wingan Inlet, *I. Pascoe*, 3 Jan 1985, VPRI 12695; *K. rubicunda*, Parramatta, Lake Parramatta, *I. Pascoe*, 28 May 1986, VPRI 13984; *Kennedia rubicunda*, Cheltenham, Cheltenham Park Native Flora Sanctuary, *I.G. Pascoe & B.C. Sutton*, 27 June 1986, VPRI 14023; *Kennedia rubicunda*, Balwyn, Maranoa Gardens, *I.G. Pascoe & B.C. Sutton*, 12 Aug. 1986, VPRI 14193a; *Kennedia* sp., Menzies Ck., 'Cotswold House', *V. Beilharz*, 28 Jan. 1989, VPRI 17456; ibid, 5 March 1989, VPRI 17458; *Kennedia* sp., Doncaster, Prop. R. & V. Beilharz, *V. Beilharz*, 20 Sept. 1989, VPRI 17461; ibid, 29 Oct. 1989, VPRI 17465; ibid, 5 Dec 1989, VPRI 17466; ibid, 5 Nov. 1990, VPRI 17467; ibid, 5 Nov 1990, VPRI 17469; *Kennedia.* sp., Cape Conran, eastern edge of Geerung R. estuary, *V. & R. Beilharz*, 17 Feb. 1993, VPRI 17413; *Kennedia* sp., Cabbage Tree, Cabbage Tree Palm Walk, *V. & R. Beilharz*, 21 Feb. 1993, VPRI 17516; *K. rubicunda*, roadside, Cann River, 20 km S of town, *R. Keogh*, 15 Aug 1976, DAR 27751. **Queensland**: *K. rubicunda,* Fraser Island, north of Kingfisher Bay Resort, Lookout Track, *I.G. Pascoe*, 19 Aug. 1992, VPRI 18155; *K. rubicunda*, Mt Greville, *J. H. Simmonds*, 29 Mar. 1975, BRIP 4523; *K. rubicunda*, Upper Burnett Ck., *J. H. Simmonds*, 20 Apr. 1973, BRIP 8842; *K. rubicunda*, Numinbah Valley, *J. H. Simmonds*, 13 June 1976, BRIP 11691.

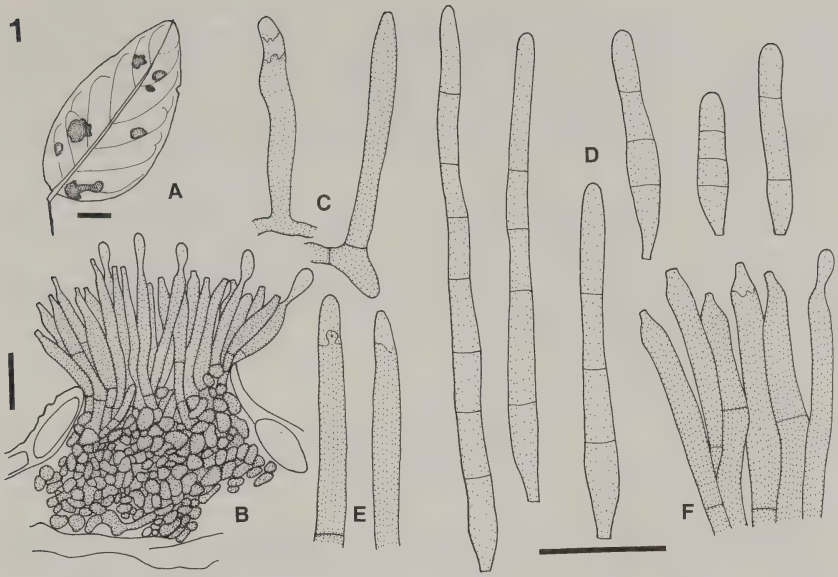

Fig. 1. ***Pseudocercospora kennediicola***
A, symptoms on leaf; B, epigenous conidioma; C, external conidiophores (VPRI 17461); D, conidia (BRIP 1691); F, conidiophores (VPRI 17460).
Scale bars: 10 mm (A), 20 μm (B–F).

New South Wales: *K. rubicunda,* Baulkham Hills, in bush, *J. Walker*, 5 Sept. 1959, DAR 4980; *K. rubicunda*, Mt. Tomah, *J. Walker*, 1 Feb 1960, DAR 4994; *K. rubicunda*, Currarong, *L.R. Fraser*, April, 1971, DAR 6569; *K. rubicunda,* south of Bateau Bay, Upright Point, *R. Keogh*, 11 Oct. 1975, DAR 25859; *K. rubicunda*, near Lake Wapengo, Picnic Point, *R. Keogh*, 5 Dec 1974, DAR 27652; *K. rubicunda*, Bermagui, 5 km S of town, in bush beside Marine Drive, *R. Keogh*, 5 Dec 1974, DAR 27653; *K. rubicunda*, Bulga Plateau, Elands, Ellenborough Falls, *O.M. Williams*, 9 June 1967, DAR 30034; *K. rubicunda*, north of Batemans Bay, above Pebbly Beach, *J Walker*, 2 Oct. 1971, DAR 30035; *K. rubicunda*, Comboyne-Wingham Rd, several miles south of Mt Gibraltar, *O.M. Williams*, 9 June 1968, DAR 30037; *K. rubicunda*, near Dungog, Chichester Dam, below spillway, *O.M. Williams*, DAR 30038; *K. rubicunda*, north side of Broken Bay, in bush behind National Fitness Camp, *J. Walker*, 8 April 1967, DAR 30039; *K. rubicunda,* Mt Gibraltar summit, *O.M. Williams*, 9 June 1968, DAR 30040; *K. rubicunda*, Bateau Bay, on sand ridge behind beach, *J. Walker*, 5 Sept. 1967, DAR 30041; *K. rubicunda*, The Entrance, Tuggerah Lakes, on sandhills north of town, *J. Walker*, 3 Sept. 1967, DAR 30042; *K. rubicunda*, Laughtondale, Lower Hawkesbury, roadside near town, *O.M. Williams*, 12 June 1972, DAR 30044; *K. rubicunda*, Wauchope, Milligans Rd, 'Broken Bago', Prop. J. Mobbs, *A. Francis,* 20 Oct. 1983, DAR 48870; *K rubicunda*, Mittagong, end of Railway Pde east, in bush, *V. Beilharz*, 29Sept. 1989, VPRI 17463; *K. rubicunda*, upper Kangaroo Valley in bush, *V. & R. Beilharz,* 26 July 1989, VPRI 17436; ibid., VPRI 17464.

P. kennediicola accounts for the leaf spots on nearly all *Kennedia* specimens held in the eastern Australia herbaria VPRI, DAR and BRIP. It is distinguished from *P. kennediae*, the other cercosporoid pathogen of *Kennedia* spp. with pigmented conidia, by its longer, broader, darker, more obclavate conidia and narrower scars. There is little or no overlap in scar diameters between the two species, 2 μm being the maximum measured for the broad, obclavate conidia of *P. kennediicola* and, in all but one example in the present study, the minimum for the narrow, more or less cylindrical conidia of *P. kennediae*. *P. kennediicola* may be specific to *Kennedia rubicunda* and its hybrids and cultivars, and is the only cercosporoid fungus known to affect this species.

Pseudocercospora warcupii Beilharz, Pascoe & Parbery **sp. nov.** (Fig. 2)

Etym.: in recognition of the late Dr Jack Warcup, eminent Australian mycologist, who collected the only known specimen of this fungus.

Teleomorph: *Mycosphaerella* sp.

Mycelium immersum, conspicuum, pallidissime vel medio brunneum, inter-cellulare, laeve vel verrucosum, 2–6 μm diam. *Stromata* amphigena, subepidermalia, pallida vel medio olivaceo-brunnea, primum conidiomatalia, deinde ascomatalia. *Conidiomata* immersa vel semi-erumpentia, 27–55 μm lata x 25–47 μm profunda. *Conidiophora* absentes. *Cellulae conidiogenae* ex cellulis exterioribus conidiomatum oriundae, ± lageniformes, ad apicem hyalinae, ad basim subhyalinae vel brunneae, interdum ad apicem usque ad 4–geniculatae, 6–28 μm longa x 2–3 μm diam. *Loci conidiogeni* non incrassati, non fuscati, 0.75–1.25 μm diam. *Conidia* hyalina, filiformes, cylindracea, sinuata, truncata, multiseptata sed non conspicue, 26–88(–180) μm longa x 1.25–2 μm lata. *Hila* non incrassata, non fuscata, non refractiva, 0.9–1.1 μm diam.

Lesions hologenous, necrotic, irregular, limited by main lateral veins, commonly 2 mm, but up to 5 mm diam., often becoming confluent and covering much or all of the leaf. *Immersed hyphae* conspicuous, very prolific, pale olivaceous to medium brown, branched, septate, smooth to verrucose, broad (4–6 μm diam.) and composed of irregularly swollen cells, or narrower (2–4 μm diam.) and of uniform diameter. *Stromata* amphigenous but mostly hypogenous, usually clustered in the centre of the lesion, pale to medium olivaceous brown. *Conidiomata* immersed to semi-erumpent, 27–55 μm wide x 25–47 μm deep. *Conidiophores* lacking. *Conidiogenous cells* formed from the outer layer of stroma cells, ± lageniform, bulbous-based with a short neck 1–4 μm long, occasionally with up to 4 geniculations near the apex; the apical part hyaline and emerging enteroblastically from a brown stroma cell or pale olivaceous in the basal part fading to hyaline in the upper part, with no clearly defined transition point, 6–28 μm long x 2–3 μm diam. *Conidiogenous loci* unthickened, pale, inconspicuous, 0.75–1.25 μm diam. *Conidia* hyaline, filiform, narrow, cylindrical, sinuate, truncate, inconspicuously multiseptate, 26–88(–180) μm long x 1.25–2 μm wide. *Hila* unthickened, not darkened, not refractive, 0.9–1.1 μm diam.

Holotype: **Australia**. On living leaves of *Kennedia prostrata* R. Br., Jimmeys Creek, Grampians N.P., Victoria, *J.H. Warcup*, 12 Jan. 1981, VPRI 17684.

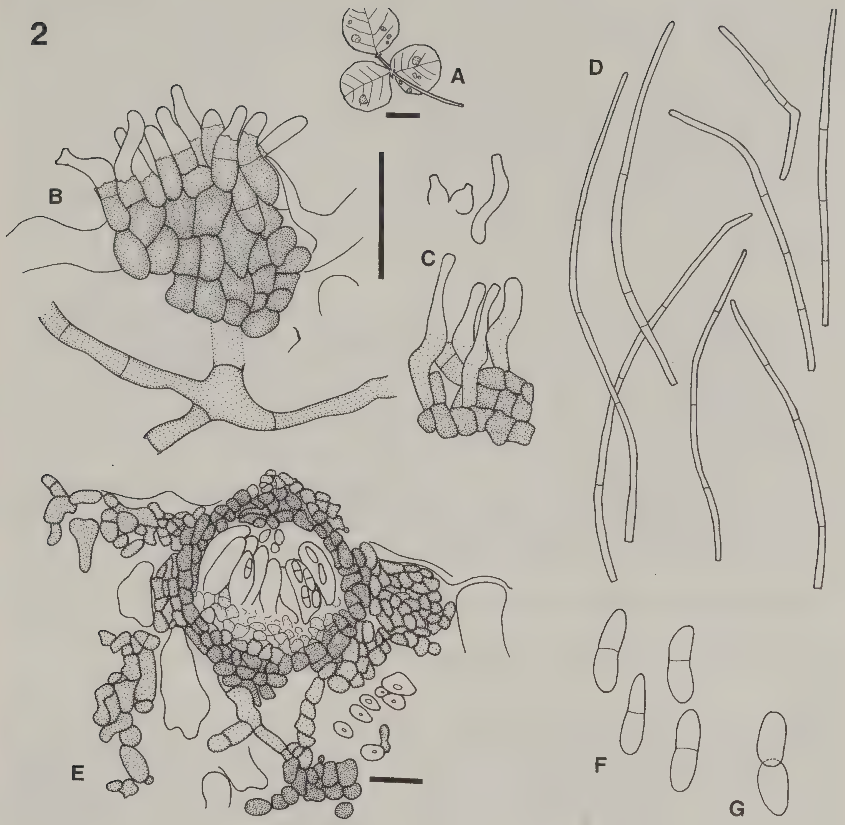

Fig. 2. ***Pseudocercospora warcupii***
A, leaf symptoms; B, conidioma; C, conidiogenous cells; D, conidia; E, ascoma; F, ascospores seen within ascus, probably immature; G, liberated ascospore.
Scale bars: 10 mm (A), 20 µm (B–G).

Known only from the type. Several attempts to collect further specimens from the type locality have been unsuccessful.

We were able to examine relatively few conidiogenous cells in *P. warcupii*, mainly owing to the need to conserve a reasonable amount of the limited available material, but also because so many conidiomata had developed into (mostly immature) ascomata, by which stage most conidiogenous cells had apparently been sloughed off. Nevertheless, persistent conidiogenous cells which had developed from the outermost stroma cells of several sectioned ascomata strongly supported the anamorph-teleomorph connection described here.

Some conidiogenous cells comprised a hyaline apical part which had emerged enteroblastically from within one of the brown cells which made up the outer cell layer of the brown stroma (Fig. 2B). The ruptured outer wall layer of the basal cell was clearly visible as an irregular frill lying against the pale wall of the emergent upper portion of the conidiogenous cell. The enteroblastic ontogeny shown by at least some conidiogenous cells of *P. warcupii* is unusual in this group of fungi, and we do not know whether it is the exception or the rule in this particular species. Conidiogenous cells with more lightly pigmented bases (stroma cells) and hyaline necks showed no such clear break in wall continuity (Fig. 2C). The conidia were hyaline, and so fine that their septation was seen only in a preparation stained with acid fuchsin.

The conidiomatal stromata of *P. warcupii* readily enlarged and developed into ascomata typical of *Mycosphaerella*. The ascomata were ± spherical, ostiolate, aparaphysate, with dark brown walls 2–3 cells thick, and were 30–86 µm diam. and up to 78 µm deep (Fig. 2E). The asci were bitunicate, but asci containing mature ascospores could not be found. Ascospores were hyaline, smooth, ovoid, straight or slightly curved, ± equally or slightly unequally 2-celled, constricted at the septum and overlapping. The ascospores pictured in Fig. 2F, which may not be fully mature, were 12–13.5 µm long x 3.75–4 µm wide, and the discharged ascospore shown in Fig. 2G which appeared mature, measured 12 x 3.75 µm .

Pseudocercospora hopetounensis Beilharz & Pascoe sp. nov. (Fig. 3)

Etym.: in reference to the town of Hopetoun, W.A., the type locality.

Mycelium immersum pallidissime brunneum, laeve, septatum, ramosum, inter-cellulare, 3-4(–6) µm diam. *Mycelium superficiale* non visum. *Stromata* amphigena, usque 110 µm diam. x 60 µm profunda, medio brunnea, erumpentia. *Conidiophora* dense sporodochiala, ad basim pallidissime brunnea, apicem versus subhyalina vel hyalina, interdum ubique hyalina, numerosissima, ramosa, septata, inter-cellulare, laevia, 0–1 septata, 9–15(–20) µm longa, ad basim 3.5–5 µm diam., apicum versus 1–2 µm diam. *Cellulae conidiogenae* in conidiophoris incorporatae, terminales, usque 4-geniculatae, 4–16 µm longaej. *Loci conidiogeni* non-incrassati, non-fuscati, c. 1.5 µm diam.. *Conidia* holoblastica, cylindracea, recta vel curvata, laevia, hyalina vel interdum sub-hyalina, ad apicem obtusa, ad basim truncata, 0–6 septata, 11–68 µm longa x 1.75–2.75 µm lata. *Hila* non-incrassata, non-fuscata, 1.25–2 µm lata.

Leaf spots hologenous, necrotic, circular or angular, discrete, 1–2 mm diam., brown or ash grey with a dark brown raised margin. *Sporulation* amphigenous. *Immersed mycelium* pale olivaceous, branched, septate, intercellular, smooth, 3–4(–6) µm wide. *Stromata* to 110 µm wide, 60 µm deep, mainly developed in the epidermal layer, medium brown, erumpent. *Conidiophores* densely sporodochial, very pale brown at the base fading to sub-hyaline or hyaline at the apices, sometimes hyaline throughout, very numerous, smooth, 0–1 septate, 9–15(–20) µm long, with a swollen base 3.5–5 µm wide attenuating to a neck 1-2 µm wide. *Conidiogenous cells* having up to 4 geniculations, 4–16 µm long. *Conidiogenous loci* c. 1.5 µm diam., pale and thin, left on sloping shoulders following sympodial proliferations of the conidiogenous cells. *Conidia* pale grey in mass, holoblastic, cylindrical, straight or curved, smooth, hyaline

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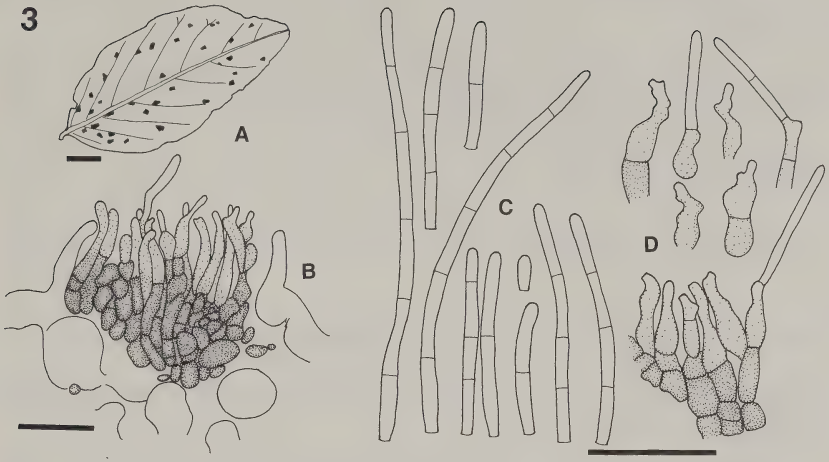

Fig. 3. ***Pseudocercospora hopetounensis***
A, leaf ; B, conidioma; C, conidia; D, conidiophores and conidiogenous cells, several with conidium initials at their apices. DAR 35204.
Scale bars:10 mm (A), 20 μm (B–D).

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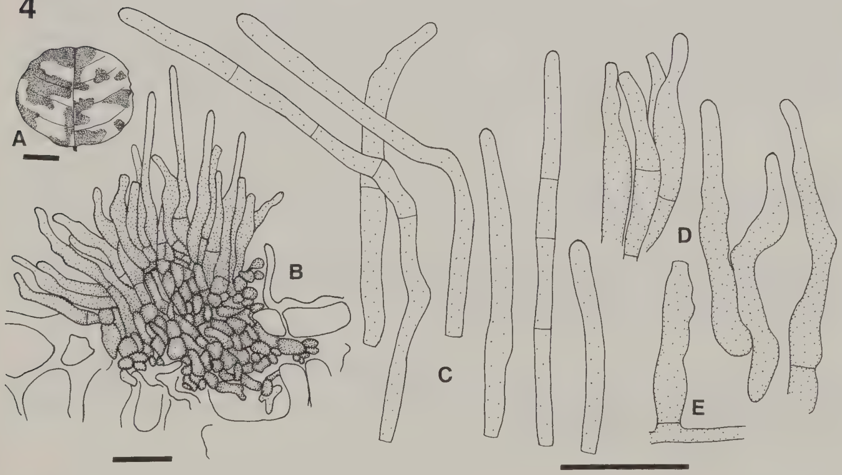

Fig. 4. ***Pseudocercospora kennediae***
A, leaf; B, conidioma; C, conidia; D, conidiophores and conidiogenous cells; E, external conidiophore. Holotype, Herb. K. Scale bars: 10 mm (A), 20 μm (B–E).

or occasionally subhyaline, 0–6 septate, not constricted at the septa, apex obtuse, base truncate, 11–68 μm long x 1.75–2.75 μm wide. *Hila* thin, pale, inconspicuous, 1.25–2 μm diam.

Holotype: **Australia**. On living leaves of *Kennedia nigricans* Lindley, Western Australia, Hopetoun, *J. Binet*, April 1980, DAR 35204.

Known only from the type.

Pseudocercospora kennediae (Cooke & Massee) U. Braun, Sydowia **48**, 213 (1996) (Fig. 4)

Cercospora kennediae (as *kennedyae*) Cooke & Massee. Grevillea **19**, 90 (1891).

The orthography of the specific epithet is corrected to conform with the original spelling of the host genus.

Lesions hologenous, necrotic, angular, vein-limited, initially 1 mm diam., up to c. 8x3 mm when confluent, and eventually covering much of the leaf. Sporulation amphigenous, mainly epigenous. Immersed mycelium very pale olivaceous, smooth, 2.25-3.75 μm wide. External mycelium pale olivaceous, 2–3 μm diam. Epigenous stromata abundant, pale brown, stomatal or sub-epidermal, erumpent, 51-105 μm diam. x 34-60 μm deep. Hypogenous stromata sparse, pale brown, substomatal or sub-epidermal. Conidiophores pale brown at the base, paler towards the apices (new growth subhyaline), 0-2 septate, ± cylindrical, becoming 1-2 geniculate towards the apices, 14–40 μm long x 3–5 μm diam. Conidia silver-grey in mass, subhyaline, narrowly obclavate to cylindrical, straight, curved or bent, semipersistent, base truncate to slightly convex, and often slightly flared with a minute frill, apex obtuse, (28–)45–95(–116) μm long x (2.25–)2.5–3.5(-4.25) μm wide. Hila pale, thin, (1.5–)2–3.5(–3.25) μm diam.

Holotype: **Australia**. On living leaves of *Kennedia* (as *Kennedya*) *prostrata* R. Br., Victoria., *Martin*, No. 603, K.

Additional specimens examined: *K. prostrata, F. Martin*, locality unknown, Vic., Australia, 1900, VPRI 2420, probable isotype; on *K. prostrata,* Durras Lake, N.S.W., Australia, *E. Gauba*, 6 May 1956, Reliquiae Petrakianae 1352 (GZU).

Several leaves of the GZU specimen appear almost entirely colonised by the fungus, but careful examination revealed minute unaffected interveinal areas scattered through the generally brown, necrotic tissue.

DISCUSSION

Of the three newly described species on *Kennedia* spp., *P. kennediicola* fits comfortably within the current broad circumscription of the genus *Pseudocercospora* (Pons & Sutton, 1988). It displays pseudopercurrent proliferation, unthickened scars and pigmented stromata, conidiophores and conidia. *P. kennediae* is also suitably placed in this genus, with its unthickened scars and pale olivaceous fungal parts. Its mode of proliferation appears likely to be sympodial, although the only supporting evidence for this is an occasional geniculation seen about halfway down some conidiophores. There is no evidence of enteroblastic proliferation, but the very pale pigmentation of the conidiophores would make this difficult to detect.

The generic disposition of *Pseudocercospora warcupii* is more problematic. The combination of hyaline, acicular conidia, and either totally or apically colorless conidiogenous cells with pale, inconspicuous scars suggests that the fungus could be accommodated in *Pseudocercosporella*, a genus described as having hyaline conidia and conidiogenous cells which are hyaline or almost so (Deighton, 1973; Braun, 1995). However, the conspicuously dark pigmentation of the stromata and the brown immersed hyphae fall well outside the limits of that genus, which is accepted as having hyaline or barely pigmented stromata and hyaline immersed hyphae (Braun, 1995). The species therefore combines characteristics of *Pseudocercospora* (the colored components) and *Pseudocercosporella* (the hyaline components) but fits neither particularly well. Hyaline conidia are known for *Pseudocercospora*, although they are rare (Braun, 1995), so the species is not disqualified from the genus on this account. Results of a molecular study of *Mycosphaerella* species and their anamorphs from eucalypts (Crous, 1998) showed a close association between the anamorphic genera *Pseudocercospora*, *Pseudocercosporella* and *Stenella*. Crous commented that although *Stenella* is morphologically quite distinct from the other two genera. *Pseudocercospora* and *Pseudocercosporella* are morphologically similar. The *Kennedia* fungus can therefore be sensibly regarded as an intermediate type between two closely related genera, having perhaps a slightly greater affinity for *Pseudocercospora*, the genus into which it has been placed.

P. hopetounensis, like *P. warcupii*, displays predominantly hyaline conidia, although a few subhyaline conidia were observed and the pale greyish tinge of the conidia seen in mass presumably indicates the presence of slight pigmentation. As the conidiophores also are occasionally hyaline, this species is another example of a marginal *Pseudocercospora* with affinities for *Pseudocercosporella*. However, the well pigmented stroma and the pale olivaceous immersed hyphae strongly support the placement of this species in *Pseudocercospora*.

Key to *Pseudocercospora* spp. on *Kennedia* spp.

1	Conidia pigmented	**2**
1'	Conidia hyaline or nearly so	**3**
2	Conidia obclavate, pale olivaceous, > 4 μm wide; hila ≤ 2 μm diam. On *K. rubicunda*	***P. kennediicola***
2'	Conidia cylindrical or very narrowly obclavate, not darkened, unthickened, non-refractive, olivaceous to subhyaline, mostly < 4 μm wide; hila ≥ 2 μm diam. On *K. prostrata*	***P. kennediae***
3	Conidia cylindrical, hyaline (rarely subhyaline), 1.75–2.75 μm diam.; conidiogenous cells 1–4 geniculate at the apices. On *K. nigricans*	***P. hopetounensis***
3'	Conidia cylindrical, hyaline, 1.25–2 μm diam.; conidiomata readily developing into *Mycosphaerella* ascomata. On *K. prostrata*	***P. warcupii***

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MYCOTAXON

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NOTES ON TWO CORTICOLOUS LICHENS FROM SOUTH AMERICA

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Abstract: Range extensions for two microlichens are reported. The tropical *Cresponea proximata*, previously known fom Brazil and Chile, is recorded for Paraguay for the first time. *Miltidea ceroplasta* has an austral distribution, known from Australia, New Zealand and Chile, and is here recorded for Argentina.

Key words: microlichens, flora, Argentina, Paraguay

INTRODUCTION

Despite their undisputed abundance and diversity in South America in numerous ecosystems (e.g. rainforest, desert, steppe), corticolous crustose microlichens remain poorly known in that area. Two overlooked and interesting lichens were recently collected by us in South America, *Cresponea proximata* (Arthoniales) and *Miltidea ceroplasta* (Lecanorales). The first is a new record for Paraguay and the latter is reported for Argentina for the first time. Previously, the genus *Cresponea* was reported in South America from Brazil and Chile and *Miltidea* only for Chile (Galloway & Quilhot 2002, Marcelli 2002).

Cresponea proximata, was found in the National Park Cerro Corá, close to the Aquidabán river (Depto. Amambay, NE Paraguay, 22° 39′- 56° 00′). *Myltidea ceroplasta*, was collected in the cool temperate rainforest in the National Park Lanín (Neuquén Province, SW Argentina, 39° 35′S - 71° 30′), around river Turbio.

The literature on microlichens in Paraguay and Argentina are scarse and widely dispersed (e.g. Calvelo & Liberatore 2000, Ferraro 1997, Feuerer 2001, Grassi 1950, Malme 1927, 1929, 1934a,b, 1936a,b, Osorio 1970, 1987), especially those concerning bark-inhabiting lichens (e.g. Calvelo & Lorenzo 1989, Messuti 1995, Messuti & Archer 1995, Vobis *et al.* 1995). Therefore, corticolous microlichens have seldomly been reported or described in taxonomic or floristic publications of this region. The two species are briefly discussed and a description based on South American material is given below.

MATERIALS AND METHODS

Specimens from the herbaria BCRU and CTES were examined.
Microscopy: The techniques used for the examination of specimens have been described previously (Messuti 1995). Sections of the fruiting bodies were mounted in water for measurement of the spore size, asci and paraphyses.
Chemistry: Chemical analyses follow the the standard techniques published by White & James (1985).

RESULTS AND DISCUSSION

Cresponea proximata (Nyl.) Egea & Torrente

Mycotaxon **48**: 328-330 (1993). *Lecanora proximata* Nyl., *Ann. Sci. Nat. Bot.* sér. **4**, **19**: 356 (1863). *Lecanactis proximata* (Nyl.) Zahlbr., *Cat. Lich. Univ.* **2**: 544 (1924), type: Cuba, *C. Wright* (H-NYL 5423 p.m.; lectotype, not seen).

(Fig. 1)

Thallus greyish, continuous, cracked or rimose. Apothecia scattered, sessile, constricted at base, 0.2-2 mm diam., with a smooth or crenulate margin, concolorous with disc, disc plane or slightly convex, with a green to green-yellow pruina. Hymenium colourless, I+ reddish. Subhymenium pale brown, I+ blue. Paraphysoids up to 2.5 μm, apical cells thickened, capitate, with a brown cap. Asci 8-spored, sub-clavate, 60-70 x 16-19 μm. Ascospores fusiform, 5-7 (-9) septate, straight or often curved, 28-40 x (-3) 5-6 (-8) μm, cells at the middle bigger than the ends. Pycnidia not seen. Thallus and medulla K-, C-, KC-, P-. TLC: nil.

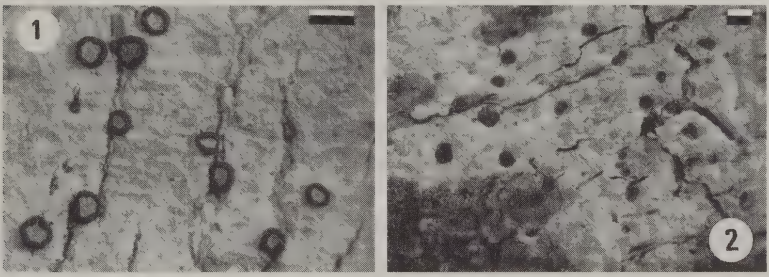
A full description of this species and its synonymy can be found in Egea & Torrente (1993). In 1926 Malme described *Lecanactis leprieurii* f. *brachyospora* from Matto Grosso (Brazil). This form is nowadays accepted as belonging to *C. proximata*. Later, Egea & Torrente (1993) cited this species from other localities of this country (Rio Grande do Sul and along the Uatuma river). The species was formally known from Japan, China, India, Taiwan, Australia, Papua New Guinea, Phillipines, Samoa, Cuba, Dominican Republic, Jamaica and Brazil. According to Galloway (1996) this species shares two distributional patterns, Neotropical and Western Pacific (= Indo-Malayan); other authors describe it as pantropical (Egea *et al.* 1996).

The species is found in disturbed rainforests of the Cerro Corá, near the Aquibadán river at ca. 700 m altitude. This area, surrounded by numerous rivers and streams, it characterized by vegetation dominated by the families Fabaceae, Lauraceae and Myrtaceae, and also *Bambusia* sp. and *Scheelea* sp.

One further species of *Cresponea* was reported from South America, *C. follmannii* (Dodge) Egea & Torrente, known only from the type locality

Aconcagua Province, Chile). This taxon, however, is readily distinguished from *C. proximata* by the size and number of septa of the ascospores [15-20 (-22) x 4-4.5 µm, 3 (-4) septate].

Specimen examined. **Paraguay:** *Depto. Amambay*, Parque Nacional Cerro Corá, in shelterd rainforest, near the monument, 15 September 1988, *Ferraro* et al. 3501 (CTES).



Figures 1-2. Morphology of the species. 1. *Cresponea proximata* (*Ferraro et al.* 3501, CTES). 2. *Miltidea ceroplasta* (*Messuti* 0214, BCRU). Scale bars = 2 mm.

Miltidea ceroplasta (Church. Bab.) D. Galloway & Hafellner
Beih. Nova Hedwigia **79**: 308 (1984). *Biatora ceroplasta* Church. Bab., *Fl. N.Z.* **3**: 300 (1855), type: New Zealand, sine loco, *Colenso* (BM; holotype, not seen).

(Fig. 2)

Thallus whitish, creamish to greenish-grey, continuous, rimose, smooth or slightly papillate, with numerous reddish immature apothecia. Apothecia scattered, sessile, 0.1-2 (-2.5) mm diam, with margins entire or crenulate, concolorous disc, disc plane to convex, smooth or granular, epruinose. Epihymenium yellow-brown, I+ blue. Hymenium colourless, I+ blue. Paraphyses simple, septate, anastomosed, clavate, at the apices ca. 4 µm diam. Asci 8-spored, cylindrical to clavate, 65-80 (-128) x 10-15 (-24) µm. Ascospores uniseriate to biseriate, ellipsoid to ovoid, usually halonate, 12-15.5 x 8.5-12 µm. Thallus and apothecia K+ purple, epihymenium K+ yellow.

There are some variations in the description of the species in the literature regarding the diagnostic K reaction and also, between our examination even in the young apothecia (Kantvilas & James 1991). When Galloway (1985) described *Lecidea ceroplasta* (= *M. ceroplasta*), he mentioned the apothecia and epihymenium having a K+ purple-magenta reaction (presence of an anthraquinone pigment). Kantvilas & James (1991) comment thatthe K reaction in the apothecia varies from K+ crimson to K+ yellow linked with the age. In our material, this character is more variable and it is not related with the maturity of the apothecia.

For additional comments and a full description see Galloway (1985), Hafellner (1984) and Kantvilas & James (1991). The ocurrence of this species in Tasmania, New Zealand, Chile and southern Argentina indicates that it has an Austral distribution pattern. This poorly and rarely collected species is the only member of the genus *Miltidea.*

The Patagonian specimen of *M. ceroplasta* was collected in the Lanín National Park, ca. 1250 m altitude, near Turbio river, in the north side, at the base of the volcano Lanín. The common trees included in this part of the National Park are *Nothofagus alpina*, *N. antarctica*, *N. pumilio* and some dispersed tress of *Araucaria araucana*. The species grows on smooth bark on low branches or on middle parts of the trunk of *Nothofagus pumilio*, mostly in deep shade. The ecology agrees well with that described from the Tasmanian and New Zealand collections where the species was reported as an epiphyte in lowland and subalpine areas. The flora in southwestern Argentina and Chile is characterized by *Nothofagus* forests, its lichen flora is related with the *Nothofagus* lichen flora of New Zealand, Tasmania and south-east of Australia. *Miltidea ceroplasta* is a further example of a southern cool temperate disjunction between Australasia and South America which was discussed in detail by Galloway (1996).

Specimen examined. **Argentina:** *Provincia de Neuquén*, Parque Nacional Lanín, Seccional Tromen, at the back of the "game-keeper" house, on the Turbio river, on *N. pumilio* bark, 16 February 1994, *Messuti* 0214 (BCRU)

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A NEW DICTYOSPORIUM SPECIES FROM MUSA ACUMINATA IN THAILAND

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Abstract A new species of *Dictyosporium* found on *Musa acuminata* in Thailand is described and illustrated. This very distinctive species, which bears lateral appendages, is compared with other species in the genus.

Keywords banana; hyphomycete; microfungi; mitosporic fungus; saprobe

Introduction

The genus *Dictyosporium* was introduced by Corda (1836). *Dictyosporium* species have been recorded world wide as saprobes on dead wood, decaying leaves and palm material (Ellis, 1971; Matsushima, 1975, 1993; Goh and Hyde, 1999; Photita *et al.*, 2001). The genus is characterised by compact sporodochia, with mostly immersed mycelium. Conidiophores are micronematous or absent. Conidia are holoblastic, solitary, dematiaceous, cheiroid with multiple columns of cells, closely branched from the base, without the arms separating, in most species flattened in one plane, and then seceding rhexolytically (Damon, 1952; Ellis, 1971; Sutton, 1985; Goh *et al.*, 1999). A few *Dictyosporium* species have conidia provided with appendages, which are thin-walled, hyaline, cylindrical, filiform or globose in shape (van Emden, 1975; Bhat and Sutton, 1985; Sutton, 1985; Tzean and Chen, 1989; Chen *et al.*, 1991). Several species of the genus have been grown *in vitro* and sporulate readily in culture (von Arx, 1981; Matsushima, 1975, 1980, 1981, 1993). Goh *et al.* (1999) reviewed *Dictyosporium*, accepting 22 species, and providing a key to species and synopsis of the genus. The teleomorphic state of *Dictyosporium* is unknown.

Recently, a new species of *Dictyosporium* was found, in Thailand, on decaying petioles of *Musa acuminata* Colloa (banana). This species is described and illustrated and compared with similar *Dictyosporium* species.

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Dictyosporium musae Photita, sp. nov. (Figs. 1-8)

Conidia 45-65 × 20-27 µm, ellipsoidea, laevia, modice brunnea, non complanata, in 49-77 cellulis, 7 serietibus composita, apicem in curvatis composita, cellula modice exteriorum serietum cum appendicibus tenuitunicatis, clavata vel obovoidae, 12-28 × 3-9 µm, hyalinia.

Etymology: in reference to its occurrence on *Musa*.

Colonies on natural substratum in the form of compact sporodochia, up to 535 µm diam. Conidiophores micronematous, pale brown, thin-walled, 20-23 × *ca* 3 µm. Conidiogenous cells subspherical or doliiform, determinate, 4.5-8 µm wide. Conidia 45-65 × 20-27 µm ($\overline{x}$ = 55.9 × 23.5 µm, n = 20), ellipsoid, smooth-walled, uniformly medium brown, non-complanate, consisting of 49-77 cells arranged in 7 slightly curved rows. The rows of cells are tighly appressed together as a cylinder and separate only under pressure. Each row of cells is 6-9 µm wide and each row terminates with an incurved hook-like apical cell. The middle cells of the outer rows are provided with 1-3 appendages, each appendage is hyaline, thin-walled, clavate to obovoid, measuring 12-28 × 3-9 µm.

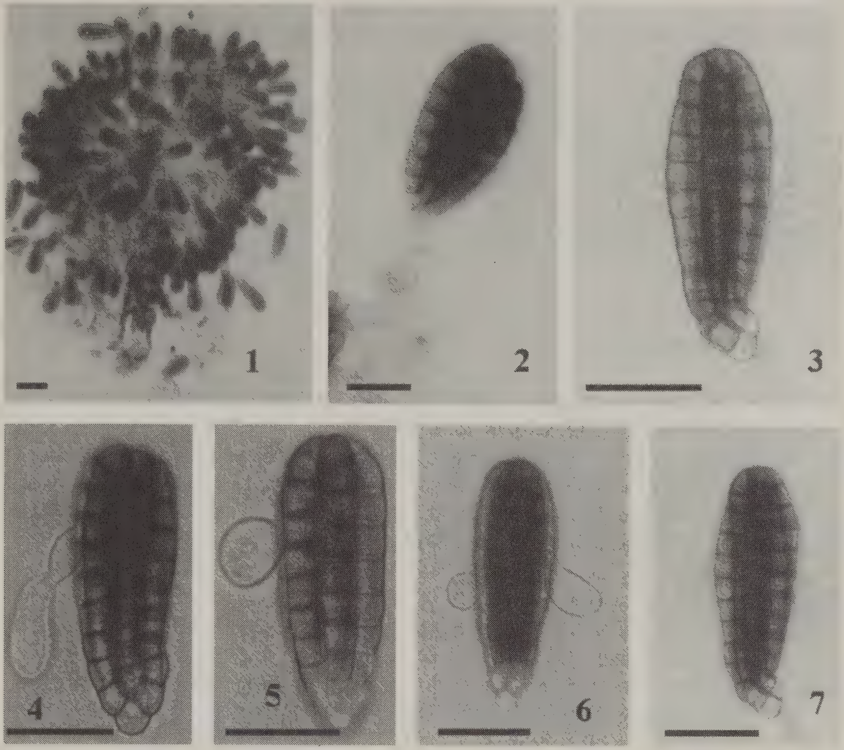
Holotype: THAILAND, Mae Hong Son Province, Sob Mei, Huay Thicha Village, on decaying petioles of *Musa acuminata*, 23 Nov. 2000, W. Photita (PDD 74135, BCC 8142 living culture).

Notes: This species is similar to *Dictyosporium giganticum* Goh & K.D. Hyde, *D. heptasporum* (Garov.) Damon and *D. subramanianii* B. Sutton in having conidia with arms which are somewhat recurved or hooked at the apex. However, these three species differ in conidial size and lack appendages when compared to *Dictyosporium musae* (Table 1). Six species of *Dictyosporium* have conidia provided with appendages: *D. alatum* Emden, *D. bulbosum* Tzean & J.L. Chen, *D. digitatum* J.L. Chen, C.H. Hwang & Tzean, *D. nigroapice* Goh, W.H. Ho & K.D. Hyde and *D. tetraseriale* Goh, Yanna & K.D. Hyde. However, in all of these species the appendages are more or less apical on the conidia, and the conidia are all complanate. Conidia of *D. musae* have appendages in the middle cells of the outer rows, and they are not complanate. *Dictyosporium musae* is therefore distinct in the genus.

During this study a second species of *Dictyosporium* was also found.

Dictyosporium heptasporum (Garov.) Damon, Lloydia 15: 118, 1952

Specimen examined: THAILAND, Mae Hong Son Province, Sob Mei, Huay Thicha Village, on decaying petioles of *Musa acuminata*, 23 Nov. 2000, W. Photita (CMUBS67).



Figs. 1-7. 1. Sporodochia of *Dictyosporium musae*. 2-7. Conidia with appendages. Bars = 20 µm

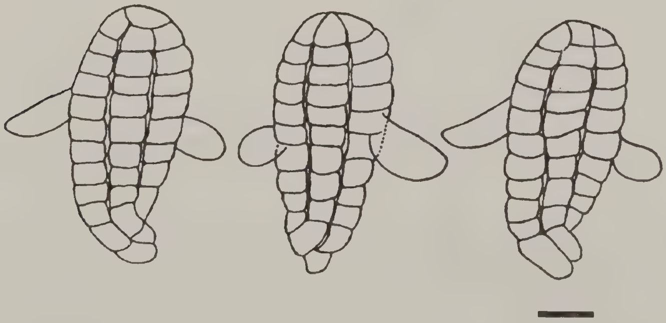


Fig. 8. Diagrammetic representation of *Dictyosporium musae*. Bar = 10 µm.

Table 1. Comparison of *Dictyosporium musae* with *D. giganticum*, *D. heptasporum* and *D. subramanianii*.

Species	Size of conidia (μm)	Rows of cells	appendages
D. giganticum	105-121 × 25-32	7	-
D. heptasporum	50-80 × 20-30	7	-
D. musae	45-65 × 20-27	7	+
D. subramanianii	33-42 × 16-20	6-7	-

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NEW COMBINATIONS AND RECORDS OF LICHENIZED-FUNGI FROM SOUTHERN SOUTH AMERICA

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ABSTRACT: The new combinations *Arthothelium diffluens* and *Ramboldia petraeoides* var. *concava* are proposed. The genus *Ramboldia* is reported for the first time from the Americas. *Cliostomum flavidulum*, *Lithographa subantarctica* and *Porpidia tuberculosa* are reported for the first time from S. America. *Schismatomma graphidioides* probably has not been correctly recorded from South America, records from Argentina and Chile being based upon the saxicolous *Stigmatidium graphidioides*.

KEYWORDS: ***Arthothelium, Lithographa, Ramboldia, Cliostomum, Schismatomma***

INTRODUCTION

Dr Henry A. Imshaug collected lichens in southern South America on three occasions, December 1967-February 1968 - Brunswick Peninsula (Chile) and the Falkland Islands (with R. C. Harris), September-October 1969 (Chile – with K. Ohlsson) and October-November 1971 (Argentina – with K. Ohlsson). They made approximately, 13,000 collections, many of which Dr Imshaug and his students sorted to genus, or even species. Some of these collections have been accessioned into the Michigan State University Herbarium (MSC) but many more have remained unaccessioned and stored in cardboard boxes. All of these collections need to be re-assessed in the light of taxonomic advances made over the intervening 30 years. The US National Science Foundation recently awarded Michigan State University a grant to 're-activate' Dr Imshaug's collection that has facilitated access to this extensive resource – which also includes important collections from Juan Fernandez Islands (Chile), Campbell and Auckland Islands (New Zealand), the Kerguelen Archipelago, the West Indies and North America.

A preliminary investigation of some of the collections from southern South America has resulted in the following additions and changes to the lichen flora of the continent.

All specimens cited are held in MSC unless otherwise noted.

NEW COMBINATIONS

Arthothelium diffluens (Nyl.) Imshaug & Fryday comb. nov.

Basionym: *Lecidea diffluens* Nyl., in *Lich. Fueg. et Patagon* 17 (1888):. Synonyms: *Heterothecium diffluens* (Nyl.) Müll.Arg., *Nuovo Giorn. Bot. Ital.* **21:** 48 (1889). *Lopadium diffluens* (Nyl.) Darb., *Wiss. Ergebn. Schwed. Südpolarexp.* 1901-1903, **4** (11): 49 (1912). *Rhizocarpon diffluens* (Nyl.) Zahlbr., *Cat. Lich. Univ.* **4:** 353 (1926)

This taxon appeared in the both Galloway & Quilhot (1998) and Calvelo & Liberatore (2000) as *Lopadium diffluens* (Nyl.) Darb., but it is clearly referable to the *Arthoniales*. *Arthothelium* and *Arthonia* have traditionally been separated on ascospore septation – ascospores of *Arthonia* having only transverse septa, those of *Arthothelium* being muriform. Grube & Giralt (1996) showed that ascospore septation is not a good character for the separation of these two genera but as generic concepts are still unclear in the group (Tehler 1993a, Grube 1998) the species is provisionally removed to *Arthothelium* so that it is at least in the correct Order!

As there appears to be no recent description of this species, a brief one is included here.

Thallus effuse, thin, pale creamy-brown, usually covering relatively large areas (to 15-20 cm diam.). *Photobiont* chlorococcoid, cells (9)12-15(-18)µm diam.

Apothecia scattered, dark brown, arthonioid, sessile, (0.2)0.3-0.4(0.6))mm diam., ±round, becoming irregular when old, flat to slightly convex, without visible exciple. *Hymenium* hyaline, I+ blue, 125-150µm tall; epihymenium brown (K+ olivaceous), granular, 12-20µm wide. *Paraphysoids* very fine, 1.0-1.5µm, branched and anastomosing, strongly conglutinate in K. *Asci* clavate, 70-80 x 35-40µm. *Ascospores* hyaline, 8/ascus, 27-35 x 12-13.5µm, muriform, 5-7 longitudinal septa, 1-2 transverse septa, outer wall I+ blue. *Hypothecium* pale brown, 70-80 µm high, clearly separated from the thin dark-brown excipulum that extends below the hypothecium. *Excipulum* cupular, poorly developed, thin, 15-20µm wide hyaline with a dark brown (K+ olivaceous) outer zone c.7.5µm wide.

Conidiomata pycnidia, usually present, brown, immersed, 0.1mm wide, walls brown (K+ olivaceous) above, hyaline below, *Roccella*-type. *Conidia* simple, bacilliform c. 7-8.5 x 0.8µm, arising from, simple, barely differentiated conidiogenous cells, Type I of Vobis (1980).

Chemistry: Thallus and apothecia C-, K-, KC-, Pd-, Unfortunately, the original collection of *Lecidea diffluens* Nyl. was not available for study at the present time but Dr Imshaug had it on loan for many years and I have no hesitation in accepting his determination.

A. diffluens is separated from all other saxicolous species of *Arthothelium* s. lat. by its sessile apothecia and large ascospores. From the collection details, *A. diffluens* appears to be a maritime species. Associated species are few and not easily identified beyond genus but include *Buellia* sp., *Caloplaca* sp., *Verrucaria* sp.

This species has also been collected more recently from Kerguelen (R. Poulsen, *pers. comm.*). *Arthothelium evanescens* Øvst. *in ed.* from the Prince Edward Islands (Øvstedal, *pers. comm.*) is also a probable synonym.

Specimens Examined: CHILE: Brunswick Peninsula, *Imshaug* 39628, Isla Desolacion, *Imshaug* 44735, 44753, 44780; Strait of Magellan, *Imshaug* 45086, 45095, 45386. FALKLAND ISLANDS (ISLAS MALVINAS): East Falklands, UTM Grid 21F VC 4777, Port William, *Imshaug* 41639A. ARGENTINA: Isla de los Estados, *Imshaug* 54034, 54036, 54045, 54046. KERGUELEN: *Poulsen* 536, 537 (C).

Ramboldia petraeoides* var. *concava (Müll. Arg.) Fryday comb. et stat. nov.
Basionym: *Lecidea concava* Müll. Arg. in *Nuovo Giorn. Bot. Ital.* **21**: 45 (1889).

Ramboldia petraeoides (Nyl. *ex* Bab. & Mitt.) Kantvilas & Elix is a distinctive species. Although the thallus colour is extremely variable, varying from creamy-brown to grey, it is characterized by its apothecial anatomy- similar to *Pyrrhospora* - and thalline chemistry – norstictic acid (K+ red crystals in microscopic section).

The South American specimens in MSC assigned by Dr Imshaug to *L. concava* are a uniform population agreeing with Müller's original collection in all respects, apart from having a somewhat paler thallus. They were compared with specimens of *Ramboldia petraeoides* from Australia and New Zealand held in MSC, which indicated that they were clearly referable to *Ramboldia* and very similar to *R. petraeoides.* Ascus structure and other characters are all in good agreement with those published for *Ramboldia* (Rambold 1989, Kantvilas & Elix 1994), differing only in consistently having distinctly capitate paraphyses and a much-reduced exciple, a consequence of the innate apothecia (Poelt 1987), although the excipular hyphae have distinctly capitate marginal cells. There is also a tendency for the ascospores to be more broadly ellipsoid. The primary difference between the two populations is that, whereas Australasian specimens usually have sessile apothecia all specimens from S. America have consistently innate, concave to flat apothecia (Fig 1). These variations are all at the extreme of the range published for *R. petraeoides* and it is considered that, given the geographical separation of the two populations, they are sufficient to warrant the recognition of the S. American collections at infra-specific rank.

The S. American specimens accessioned into MSC as *Lecidea concava* are all from the Falkland Islands but this is probably because the collections from mainland S. America are largely unaccessioned. The one mainland specimen, from Isla de los Estados, was discovered as an associated species on an unaccessioned *Rhizocarpon* collection.

Specimens Examined: ***Ramboldia petraeoides* var. *concava*:** FALKLAND ISLANDS (ISLAS MALVINAS): West Falklands, West French Peak, *Imshaug* 40932, 40933, 40934, 40936A, 40938; East French Peak, *Imshaug* 40974, 40979; French Peaks, *Imshaug* 41026, 41032B; Mt Adam, *Imshaug* 41053A, Mt Fegen, *Imshaug* 41176, 41179, 41183, 41184; Mt Maria, *Imshaug* 41410, Mt Weddell, *Imshaug* 41970, 41973, 41983; East Head, *Imshaug* 42085, Fox bay Mt, *Imshaug* 42154, 42155, 42171. East Falklands, Two Sisters, *Imshaug* 40329, 40341A, 40336, 40364, 40369, 40391B, 40406; Sapper Hill, *Imshaug* 39719B, 39747, 39796C; Mt Usborne, *Imshaug* 39983, 40052, 40086A, 40069, 40121, 40122, 40136; Tumbledown Mt, *Imshaug* 39663, Mt Kent, *Imshaug* 40431A, 40440, 40469; Goat Ridge, *Imshaug* 41503A, 41528A; Mt Harriet, *Imshaug* 41547, Mt Low, *Imshaug* 41586. ARGENTINA: Staten Island [Isla de los Estados], Port Cook, 1888, *Spegazzini* (G-Holotype), *Imshaug* 52585.
***Ramboldia petraeoides* var. *petraeoides*:** AUSTRALIA, New South Wales, *Streimann* 44776, 45042, 47042, 49565, 60300; Victoria, *Streimann* 38130, 48087, 50887, 50892, 53360, 53677, 55340, 59465. NEW ZEALAND, Campbell Island, *Harris* 5084; Southland, *Imshaug* 58020; Otago, *Imshaug* 56138, 45129.

NEW TO SOUTH AMERICA

Cliostomum flavidulum Hafellner & Kalb
In Kalb & Hafelllner *Herzogia* **9**: 61 (1992).

There are several folders of specimens referred to *Catillaria aeruginascens* (Müll. Arg.) Zahlbr. in MSC. They do not represent a single species but include specimens with both sorediate and esorediate thalli and reacting PD+ orange-red (protocetraric acid) or Pd-. The specimens with a sorediate thallus containing protocetraric acid are clearly referable to *Cliostomum flavidulum* Hafellner & Kalb, a species and genus apparently new to South America.

Inspection of the type material of *Patellaria aeruginascens* Müll. Arg. showed that it was not conspecific with the sorediate material in MSC and, consequently, is not an earlier name for *C. flavidulum*. Its systematic position is currently under investigation by Dr S. Ekman (Bergen).

Selected Specimens Examined: ARGENTINA: Isla Grande, *Imshaug* 50486, 50487. CHILE: Brunswick Peninsula, *Imshaug*, 39068, 39088, 39168. FALKLAND ISLANDS (ISLAS MALVINAS): West Falklands, *Imshaug* 40913; East Falklands, *Imshaug* 40590, 41507B, 41533B. ARGENTINA: Isla Grande, *Imshaug* 50067, 50074, 50082B, 50478; Isla de los Estados, *Imshaug* 50613A, 50665, 50823, 53477, 53487, 53512.

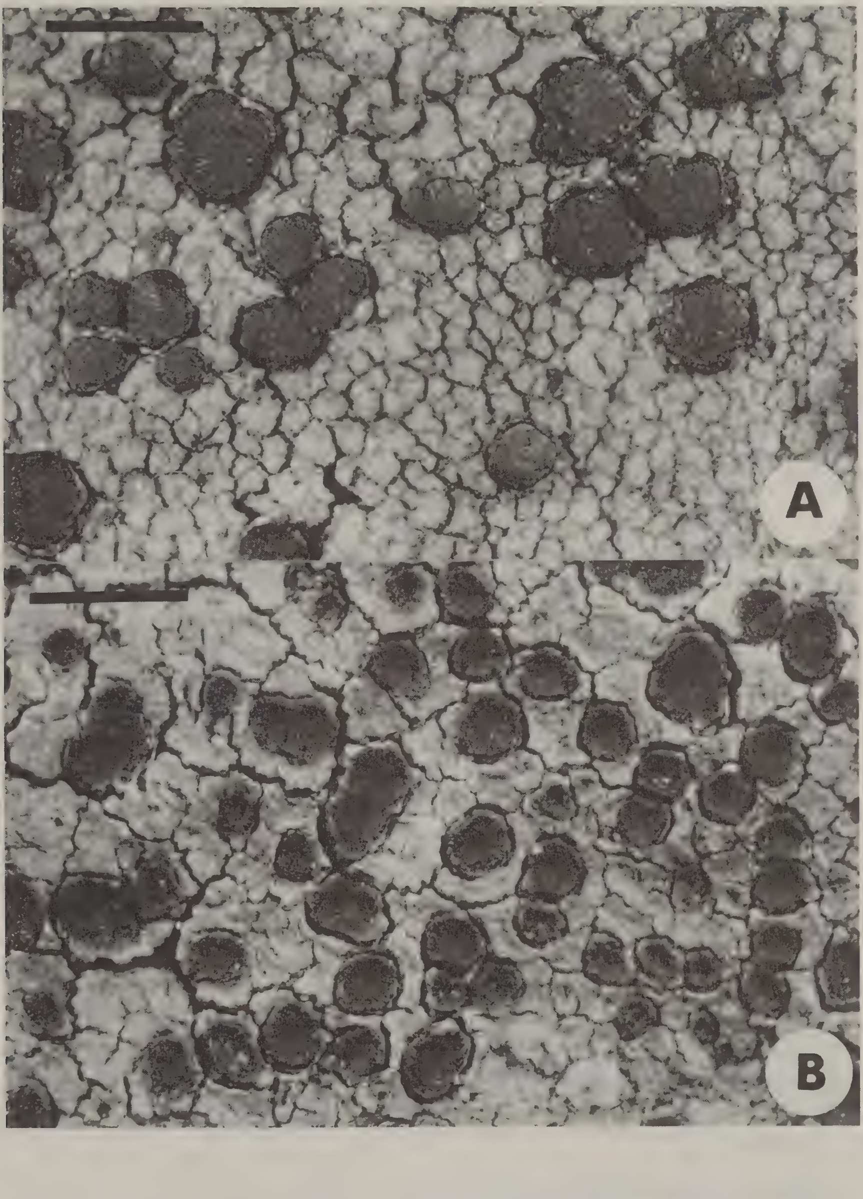

Figure 1. Thallus and apothecia of *Ramboldia petraeoides.* A: var. *petraeoides* (Streimann 53677). B: var. *concava* (holotype). Scale =1.0mm

Lithographa subantarctica Hertel & Rambold
In *Bibliotheca Lichenologica* **38**: 158-159 (1990).

Dr Imshaug annotated several specimens in MSC as *Lithographa graphidioides* (Crombie), but this combination has never been published. The collections in MSC represent at least two distinct species - both have an ochracous thallus, ±lirellate apothecia and simple ascospores but, whereas one has unbranched, often rounded apothecia with a ±exposed disc and ascospores (10-)12(-16)μm long, the other taxon has a thinner, pale yellow thallus, stellate apothecia with a consistently slit-like disc, and slightly larger ascospores.

Hertel & Rambold (1990) described the new species *Lithographa subantarctica* from the Prince Edward Islands (Marion Island) and Australia (Tasmania). Inspection of material of this taxon (including the holotype) confirmed that it was synonymous with the entity in MSC with unbranched lirellae. From the habitat details give by Hertel & Rambold and the notes on Dr Imshaug's labels it would appear that *L. subantarctica* is a species of exposed, damp siliceous rocks. Dr Imshaug also collected this species from Kerguelen, so it would appear that it has a circum-austral distribution.

Dr Imshaug's new combination, *Lithographa graphidioides,* was based upon *Stigmatidium graphidioides* Cromb. (Crombie 1876), described from a collection made by Cunningham 'ad saxa granitica. On hill, Swallow Bay (Fuegia), 30 December 1868'. Zahlbruckner (1923) included *Stigmatidium graphidioides* within the synonymy of *Schismatomma graphidioides* (Leighton) Zahlbr., even though Leighton's taxon grew on deciduous trees in Western Europe, had 3-septate, acicular ascospores, and *Trentepholia* as photobiont. Tehler (1993b) excluded *Stigmatidium graphidioides* from *Schismatomma* but was unable to suggest to which genus it should be referred. The original collection could not be found in BM but an isotype (seen by Tehler) was located in E. Comparison of this isotype with Dr Imshaug's material in MSC suggested that it was conspecific with the entity with stellate apothecia. Unfortunately, the isotype of *Stigmatidium graphidioides* is in poor condition with few apothecia and no mature asci, and so it has not been possible to confirm this opinion. The systematic position of this taxon is under further investigation.

As far as I can ascertain, the appearance of *Schismatomma graphidioides* in Galloway & Quilhot (1998) and Calvelo & Liberatore (2000) is based on *Stigmatidium graphidioides* and, unless a supporting specimen can be located, it should be removed from the lichen checklists for both Chile and Argentina.

Specimens Examined: ***Lithographa subantarctica:*** MARION ISLAND: *Hertel* 24585A (M-Holotype). AUSTRALIA: Tasmania, *Hertel* 24193b (M). CHILE: Brunswick Peninsula, *Imshaug* 39433, 39484; Strait of Magellan, *Imshaug* 45221. FALKLAND ISLANDS (ISLAS MALVINAS): East Falklands, Mt Usborne, *Imshaug* 40102; West Falklands, Mt Adam, *Imshaug* 41050, 41103; Mt Maria, *Imshaug* 41282B, 41298, 41367, 41423B. KERGUELEN: Péninsule Courbet, *Imshaug* 48981.

'Stigmatidium graphidioides' CHILE: Brunswick Peninsula, *Imshaug* 39410; Patagonian Channels, *Imshaug* 43694, 44095, 44251, 44351, 44615; Isla Desolacion, *Imshaug* 44634, 44652.

Porpidia tuberculosa (Sm.) Hertel & Knoph

In Hertel *Beiheft Nova Hedwigia* **79**: 399-499 (1984). Basionym: *Spilonema tuberculosa* Sm. In Smith & Sowerby, *Bot. Jahrb. Syst.* 36, tab. 2556 (1814).

A collection of *Rhizocarpon reductum* Th. Fr. (syn. *R. obscuratum*) collected by Dr Imshaug and Harris has a sterile sorediate crust as an associated species. This sterile crust has an amyloid medulla and a thallus containing confluentic acid and is clearly referable to *Porpidia tuberculosa* (Sm.) Hertel & Knoph. *P. tuberculosa* is a common species in Europe, where it is often colonizes freshly exposed siliceous rocks, and frequently occurs with *Rhizocarpon reductum.* On the Falkland Islands it was recorded as occurring in a 'stone-run' which would suggest a freshly exposed substratum.

This appears to be the first record of this species from the Southern Hemisphere.

Specimen Examined: FALKLAND ISLANDS (ISLAS MALVINAS): West Falklands, French Peaks, *Imshaug* 41013.

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I thank the curators of E, G, and M for arranging the loan of critical material and the curator of BM & H for searching for original material of *Stigmatidium graphidioides* and *Lecidea diffluens* respectively.

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NEW SPECIES OF THE LICHEN GENUS COCCOTREMA FROM SOUTHERN SOUTH AMERICA

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Abstract: The following three new lichen species are described and illustrated: *Coccotrema corallina* from Argentina, *Coccotrema magellanica* from Argentina and Chile, and *Coccotrema fernandeziana* from Chile.

Key words: Coccotremataceae, taxonomy, Chile, Argentina

INTRODUCTION

This paper is the second contribution in the revision of the genus *Coccotrema* (lichenised Ascomycotina) in southern South America. Until 1996, only two species were reported for southern part of Argentina and Chile, *C. cucurbitula* (Mont.) Müll. Arg. and *C. porinopsis* (Nyl.) Imshaug ex Yoshimura (Gay 1852, Grassi 1950, Messuti 1996, Redón 1974).

This genus occurs in southern South America in temperate and cool-temperate forests, and also in the Valdivian rainforest. According to the patterns of lichen distribution proposed by Galloway (1996) the three new species are endemic of southern South America. The flora in southwestern Argentina and Chile is characterized by *Nothofagus* forests, its lichen flora is related with the *Nothofagus*´s lichen flora of New Zealand, Tasmania and south-east of Australia. Although *Nothofagus* forests are absent on Juan Fernández, this area has biogeographical affinities with the subantarctic forests of southern South America and Australasia (Cabrera & Willink 1973).

One of the new species, *C. fernandeziana*, also occurs on Juan Fernández, while *C. corallina* is only from the south of Argentina in Tierra del Fuego and *C. magellanica* was reported also from Tierra del Fuego and from the central and south of Chile in Osorno and Magallanes Provinces respectively.

MATERIALS AND METHODS

Specimens from the herbarium MSC were examined.

Microscopy: The techniques used for the examination of specimens have been described

previously (Messuti 1996). Sections of the fruiting bodies were mounted in water for measurement of the spore size, asci and paraphyses.
Chemistry: The colour reactions (=spot test) were made by the standard methods according to White & James (1985). The chemical constituents were identified using thin layer chromatography (TLC) (Culberson 1972) and gradient-elution high performance liquid chromatography (HPLC) (Feige *et al.* 1993).

RESULTS AND DISCUSSION

Coccotrema corallina Messuti sp. nov.

Thallus crustaceus, tenuis, superficies laevis vel leviter verrucosa, isidiatus. Isidia coralloidea, raro digitiformia, spisse conferta, numerosa, thallo concoloria, 0.3-0.4 mm diam., 2-4 mm alta. Soredia nulla. Cephalodia inconspicua, globosa, hemisphaerica vel irregulariter hemisphaerica, albida, pruinosa, intra verrucas locata, 0.2-0.7 mm diam., algam *Nostoc* continentia. Ascocarpi typici per genum, 0.40-0.85 mm diam. Margo thallinus thallo concoloria, laevis. Sporae 8-nae, hyalina, biseriatae vel irregulariter biseriatae, ellipsoideae, 48-66 µm longae, 24-30 µm latae, parietes uniformes 3-4 µm crasso. Pycnidia ignota.

Thallus K+ aurantiacus usque ad castaneus, C-, KC-, Pd- vel Pd+ aurantiacus; acidum consticticum, acidum sticticum, acidum hypoconsticticum in magna summa continens.

Type: ARGENTINA. Tierra del Fuego Province, Isla Grande, Bahía Buen Suceso, on the top of the mountain in the alpine region, near the valley, Imshaug & Ohlsson 49994 (holotype, MSC).

Thallus crustose, thin, surface smooth to rugose, creamish to whitish-grey; soredia absent; **isidia** cylindrical, coralloid, rarely digitiform, distributed over the whole thallus, concolorous with thallus or apical portion red-brown to brown, 0.3-0.4 mm diam., 2-4 mm high, toward the external part small, simple, cylindrical, 0.2-0.4 mm diam., 0.5-1.0 mm high; **cephalodia** external, globose to hemispherical or irregular, whitish, sometimes pruinose, between the isidia, containing *Nostoc*, 0.2-0.7 mm diam.; **apothecia** zeorine, perithecia-like, immersed singly in verrucae; fertile verrucae crowded, numerose, subglobose, with a singly hyaline apical pore per verruca, area around the pore flattened to slightly depressed, 0.40-0.85 mm diam.; exciple surrounded by a smooth thalline margin concolorous with thallus; hymenium red-brown to pale brown, I+ yellow-orange, KI+ blue; **paraphyses** simple, rarely branched, ca. 1µm thick; periphysoids not seen; **asci** claviform, 200-255 x 60-85 µm; **ascospores** 8 per ascus, simple, colourless, biseriate to irregular biseriate, ellipsoid, 48-60 x 24-30 µm, wall up 4 µm thick, smooth; pycnidia not seen.

Chemistry: K+ orange to red-brown, C-, KC-, Pd- or Pd+ orange. TLC and HPLC: constictic acid (major), stictic acid (major), hypoconstictic acid (major), connorstictic acid (trace), cryptosticitic acid (trace), norstictic acid (trace), hypostictic acid (trace) and ± consalazinic acid (trace).

Additional specimens examined: ARGENTINA. Tierra del Fuego Province, Isla de los Estados, Puerto Cook, SE of the bay, Imshaug & Ohlsson 51566 (MSC).

Remarks: *Coccotrema corallina* (Fig.1) is characterized by coralloid isidia, 0.3-0.4 mm diam. and 2-4 mm high and apothecia with thalline margin not isidiate. The species can be distinguished from other isidiate *Coccotrema* species, such as *C. magellanica* by the absence of soredia, apothecia with thalline margin without isidia and the isidia morphology (see below) and *C. porinopsis* by the absence of thalline margin isidiate and the isidia morphology (Messuti 1996). Chemically *Coccotrema corallina* resembles *C. magellanica* and *C. porinopsis*, but differs from the latter species by the constant presence of hypoconstictic acid.

Etymology: The epithet *corallina* is derived from the name of the isidia type (coralloid) of the species. The name was originally proposed by Imshaug (*in sched.*).

Distribution and Ecology: *Coccotrema corallina* is a predominantly muscicolous species, but also grows on detritus and grass. The species is most commonly found in the mountainous regions in subantarctic forest at an elevation of 600 to 1000 m. It is only known from Argentina (Tierra del Fuego Province).

Coccotrema fernandeziana Messuti sp. nov.

Thallus crustaceus, tenuis, continuus usque ad discontinuus, asper usque ad verrucosus, cremeus. Prothallus nullis. Cephalodia immersa vel emergentia, irregularia, algam ?*Nostoc* continentia, superfices saepe verrucosa, 0.5-1.0 mm diam., raro numerosa. Ascocarpi typici per genum, 0.3-0.4 mm diam., zona circum ostiola aurantiaca vel rubra. Margo thallinus thallo concoloria, saepe verucosum. Sporae 8-nae, hyalinae, biseriatae vel irregulariter biseriatae, ellipsoideae, (29-) 36-64 µm longae, (12-) 19-30 µm latae, parietes uniformes circa 4 µm crasso. Pycnidia ignota.

Thallus K+ luteus, C-, KC-, Pd+ aurantiacus; acidum norsticticum in magna summa continens.

Type: CHILE. Islas Juan Fernández, Más a Tierra, Portezuelo de Villagra, Imshaug 37570B (holotype, MSC).

Thallus crustose, thin, continuous to discontinuous, surface smooth to rugose, granulose to verrucose, creamish; granules scattered or crowded, 0.05-0.25 mm diam., 0.08-0.28 mm high, showing the same colour and texture as thallus, apical portion red-brown; soredia and isidia absent; **cephalodia** infrequent, internal, immersed, rarely external, surface verrucose, containing ?*Nostoc*, 0.5-1.0 mm diam.; **apothecia** zeorine, perithecia-like, immersed, singly in verrucae, gelatinous; fertile verrucae scattered or crowded, sometimes confluent (2-3), numerose, globose, rough, with a single hyaline apical pore per verruca, area around the pore orange, brown-red to red, 0.3-0.4 mm diam.; exciple surrounded by a irregular and verrucose thallus margin concolorous with thallus; hymenium hyaline, gelatinous, I+ orange, KI+ blue, K+ red; **paraphyses** septate, anastomosing, 1-2 µm thick; periphysoids not seen; **asci** cylindrical to cylindrical-claviform, 208 x 36-40 µm; **ascospores** 6 per ascus, simple, colourless, biseriate to irregular biseriate, ellipsoid, (29-) 36-64 x (12-) 19-30 µm, wall up 4 µm thick, smooth; pycnidia not seen.

Chemistry: K+ yellow, C-, KC-, Pd+ orange. TLC and HPLC: norstictc acid (major) and ± salazinic acid (trace).

Additional specimens examined: CHILE. Islas Juan Fernández, Más Afuera, Quebrada de las Vacas, down the Cordón Barril, Imshaug 37308 (MSC). Más a Tierra, Portezuelo de Villagra, Imshaug 37547B, 37570B (MSC); Cordón de Salsipuedes, Imshaug 38141C (MSC); El Yunque, NE side, Valle Anson, Imshaug 37951C (MSC).

Remarks: *Coccotrema fernandeziana* (Fig.2) can be readily identified by the internal cephalodia, fertile verrucae with an orange to red single apical pore, thalline margin verrucose, constantly 6-spored asci and norstictic acid as major compound. Differs from other species of the genus by the morphology and position of the cephalodia. A chemically similar species is the corticolous *P. colobina* Tuck. (Tuckerman 1877, 1888) (= *C. colobina* (Tuck.) Messuti (Messuti 2002, in press, Bibl. Lichenol., Vol: Lichenological and mycological contributions in honour of G. B. Feige (Jensen, M. ed., in press) but that species has external cephalodia, apothecia with brown-red to dark brown ostiola and 6-8- spored asci.

Etymology: The epithet *fernandeziana*, refers to the locality where the type was collected at the first time (Archipelago Juan Fernández, Chile).

Distribution and Ecology: *Coccotrema fernandeziana* is an uncommon corticolous species only known from the islands of Juan Fernández. It is found in humid forests dominated by *Myrceugenia schulzei*, *Dicksonia berteriana* and *Drimys confertifolia* and in forests with *Nothofagaria* sp., *Fagara maju* and *Drimys confertifolia*.

Coccotrema magellanica Messuti sp. nov.

Thallus crustaceus, tenuis, superficies laevis vel areolata et rimosa, albo-cineraceus vel isabelinus. Serediatus et isidiatus. Soralia rara, thallo concoloria vel albida, hemisphaerica vel irregularia, plana vel subglobosa, 0.6-1.7 mm diam., soredia granulosa, 0.05-0.10 mm diam. Isidia verruciformia, cilindrica vel claviformia, saepe simple, 0.02-0.18 mm diam., 0.16-1.0 mm alta. Cephalodia globosa vel irregulariter hemisphaerica, laevia vel rugosa, isidiata, thallo concoloria, 0.9-3.5 mm diam., algam *Calothrix* (aut *Nostoc*) continentia. Ascocarpi typici per genum, 0.5-1.0 mm diam., zona circum ostiola vel castanea usque ad rubra. Margo thallinus thallo concoloria, isidiata, saepe sorediata. Sporae (6-) 8-nae, hyalinae, biseriatae vel irregulariter biseriate, ellipsoideae, 40-56 µm longae, 16.0-25.5 µm latae, parietes uniformes, circa 3 µm crasso. Pycnidia ignota.

Thallus K- vel K+ luteus usque ad ruber, C-, KC-, Pd-; acidum consticticum, acidum sticticum in magna summa continens.

Type: CHILE. Osorno Province. Refugio Antillanca, in *Nothofagus pumilio* forest, Imshaug 42876 (holotype, MSC).

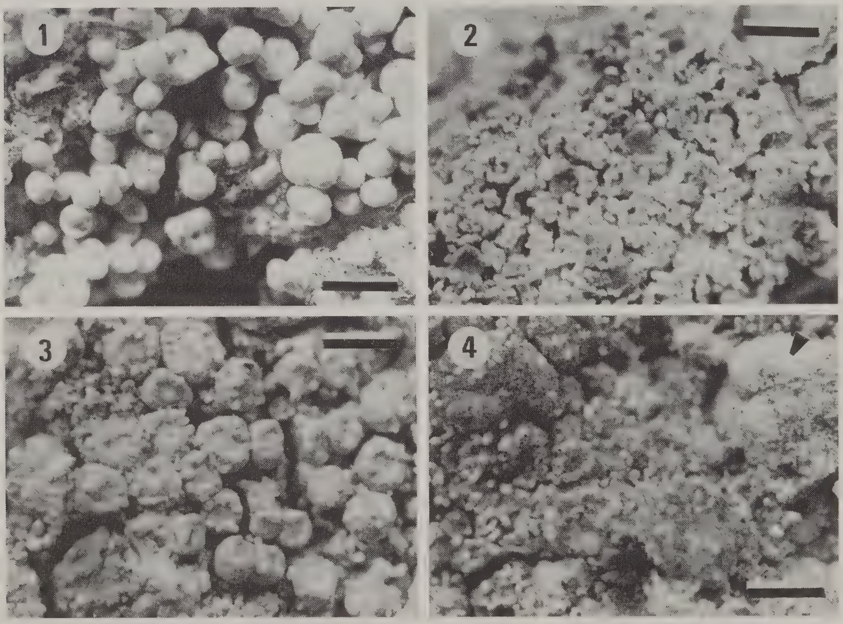
Thallus crustose, thin, surface smooth, craked to rimose-areolate, whitish-grey to pale brown; **soralia** infrequent, concolorous with thallus to white, rounded to irregular, flattened to subglobose, 0.6-1.7 mm diam.; **soredia** granulose, 0.05-0.1 mm diam.; **isidia** cylindrical to claviform, simple to branched, with the same colour as the thallus, 0.02-0.18 mm diam., 0.15-1.0 mm high; **cephalodia** external, globose to irregular, smooth to roughed, isidiate, concolorous with the thallus, containing *Calothrix* or *Nostoc*, 0.9-3.5 mm diam.; **apothecia** zeorine, perithecia-like, immersed single in verrucae; fertile verrucae crowded, numerose, subglobose, with a single hyaline apical pore per verruca, area around the pore flattened, brown reddish, 0.5-1.0 mm diam.; exciple surrounded by an irregular thalline margin concolorous with thallus, with isidia, rarely sorediate; hymenium hyaline, I+ yellow-orange, KI+ blue; **paraphyses** simple, ca. 1µm thick; periphysoids not seen; **asci** cylindrical to claviform, 164-240 x 24-44 µm; **ascospores** (6-) 8 per ascus, simple, colourless, biseriate to irregular biseriate, ellipsoid, 40-56 x 16.0-25.5 µm, wall up 3 µm thick, smooth; pycnidia not seen.

Chemistry: Thallus K- or K+ yellow to red, C-, KC-, Pd-. TLC and HPLC: consticitc acid (major), stictic acid (major), hypoconsticitic acid (major or minor), connorsticitc acid (minor or trace), salazinic acid (minor or trace), ±consalazinic acid (trace), ±cryptostictic acid (trace) and ±hypostictic acid (trace), ±norstictic acid (trace).

Additional specimens examined: ARGENTINA. Tierra del Fuego Province, Isla Grande, Bahía Buen Suceso, towards the bay N side, Imshaug & Ohlsson 50210A (MSC). Isla de los Estados, Puerto Cook, Imshaug & Ohlsson 51632 (MSC); Puerto Celular, Imshaug & Ohlsson 52669A (MSC); Bahía Capitán Cánepa, near the bay E side, Imshaug & Ohlsson 52978 (MSC).
CHILE. Osorno Province, near “refugio Antillanca”, Imshaug 42876 (MSC), Imshaug 42892B (MSC); around the Toro Lake on the way of “refugio Antillanca”, Imshaug 43099 (MSC). Magallanes Province, Penísula Brunswick, Puerto Cutter, between the cupper mine and the river, towards south of the mine, Imshaug & Harris 39348 (MSC).

Remarks: *Coccotrema magellanica* (Fig.3-4) can be identified by the verruciform, cylindrical to claviform isidia, the presence of granular soredia, apothecia with a brown-red ostiolum and isidiate thalline margin, 6-8 spored asci and the presence of constictic acid and stictic acid as major constituents. The isidia of this species are very variable in form and size. *Coccotrema magellanica* has at least three types of isidia: "isidia type 1", "2" and "3". The "isidia type 1" are similar to thalline protuberances or verrucae (*sensu* Du Rietz 1924), distributed over the cephalodia and fertile verrucae and with an average length: breath ratio of 2. The "isidia type 2" and "type 3" corresponding to typical isidia, with a cylindrical to claviform shape, simple or rarely branched, present on the whole thallus and the average length: breath ratio is between 5 ("type 2") and 14 ("type 3"). This species shows very little morphological variation. Nevertheless, many chemotypes seem to exist. Using HPLC, five different chemotypes could be detected, where stictic acid together with constictic acid are the major substances and in some cases hypoconstictic acid, too. Correlations between these five chemotypes and the morphological characters and distribution there are not observed.

Coccotrema magellanica is superficially similar to another isidiate species, *C. porinopsis* (Messuti 1996). This species, however, differs in the morphology of the isidia, secondary metabolites and the absence of soredia in the latter.



Figures 1-4. Morphology of *Coccotrema* species. 1.*C. corallina* (holotype, MSC). 2.*C. fernandeziana* (holotype, MSC). 3.*C. magellanica* (holotype, MSC). 4. *C. magellanica,* detail showing the soredia (▼) (50210A, MSC). Scale bars = 1 mm.

Etymology: The epithet *magellanica* is derived from the name of the southern region of South America where the species occurs.

Distribution and Ecology: This species occurs on bark of *Nothofagus pumilio* but can also be collected on *Drymis winteri*. It is found in subantarctic forests dominated by *Nothofagus pumilio*. In southern South America it occurs in temperate to cool-temperate areas of southern Argentina (Tierra del Fuego Province) and Chile (Osorno Province and Magallanes Province).

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AMANDINEA CACUMINUM: A NEW COMBINATION (PHYSCIACEAE, LICHENIZED ASCOMYCETES)

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ABSTRACT

Rinodina cacuminum is found to possess curved, filiform conidia, lecanorine or lecideine apothecia, and a hyaline or pigmented hypothecium. The species has previously been shown to have Bacidia-type asci and molecular data also indicate a closer relationship with the genus *Amandinea* than *Rinodina*. The species has a continuous, northern circumpolar distribution. *R. milvina* var. *melanochlora* is placed into synonymy.

Keywords. Taxonomy, *Rinodina*, conidia, phytogeography.

INTRODUCTION

The genus *Amandinea* (Choisy 1950) was validated by Scheidegger (1993) and includes crustose members of the Physciaceae with curved, filiform conidia, and lecideine or lecanorine apothecia. It therefore includes species transferred from the genera *Buellia* de Not. and *Rinodina* (Ach.) Gray which both possess bacilliform conidia. Subsequent papers dealing with *Amandinea* species are Matzer et al. (1994, *A. petermannii* (Hue) Matzer, H. Mayrhofer & Scheidegger), Sheard & May (1997, four new combinations from North America), Mayrhofer et al. (1999, *A. insperata* (Nyl.) H. Mayrhofer & Ropin), Giralt et al. (2000, *A. crassiuscula* Giralt & Etayo) and Marbach (2000, numerous tropical and subtropical species). The genus is characterized by a wide degree of variation in apothecium margin anatomy, hypothecium pigmentation and spore structure, although all species have unthickened apical spore walls. Two other genera in the family, *Australiaena* Matzer, H. Mayrhofer & Elix (Matzer et al. 1997) and *Hyperphyscia* Müll. Arg. (Hafellner et al. 1979), also possess this type of conidium. *Australiaena* is distinguished primarily by its radiate-plicate thallus margin and chemistry, and *Hyperphyscia* by its foliose thallus.

Internal ascomata measurements were made on vertical sections (20-25 μm thick), cut with a Leitz freezing microtome and mounted in Melzer's solution. Spore measurements were taken at x500 magnification after squashing sections and are quoted using the convention of Sheard (1973). Dimensions between the commas are mean length and breadth; those in parentheses are the 95% confidence limits about the mean; the range limits are two standard deviations above and below the mean, within which 95% of the spore population is expected to fall.

AMANDINEA CACUMINUM (TH. FR.) H. MAYRHOFER & SHEARD COMB. NOV.

Rinodina sophodes var. *milvina* f. *cacuminum* Th. Fr., Lichenogr. Scand. I: 201 (1871). Type: Norway: Dovre: Harbakken, 30 August 1863, *Th. M. Fries* s.n. (UPS - lectotype, Mayrhofer & Poelt 1979). *R. cacuminum* (Th. Fr.) Malme, Bot. Notiser 1896: 176 (1896). Nomen conservandum (Moberg and Mayrhofer 1998), non *R. cacuminum* (A. Massal.) Anzi, Lich. Rar. Veneti exs. no. 48 (1863) = *Leproloma cacuminum* (A. Massal.) J.R. Laundon, Lichenologist 24: 35 (1992).

Rinodina milvina var. *melanochlora* (Sommerf.) Th. Fr., Nova Acta Reg. Soc. Scient. Upsal., Ser. 3, 3: 225 (1861). - *Lecanora melanochlora* Sommerf., Suppl. Flor. Lappon. 98 (1826). Type: Norway: Nordland, Skipperstaburet, Sommerfelt s.n. (UPS - lectotype, here designated). According to Art.14 ICBN (Tokyo Code) it is necessary to conserve the constantly used name *cacuminum* against *melanochlora* which has never been in use apart from the description and combination. A corresponding proposal is in preparation.

Rinodina milvina var. *subdeflectens* (Vain.) Zahlbr., Cat. Lich. Univ. 7: 531 (1931). *Lecanora milvina* var. *subdeflectens* Vain., Meddeland. Soc. Fauna Fl. Fennica 6: 152 (1881). Type: Finland: Regio kuusamoensis: Kuusamo, Kuusamon pitäjä, Ukonvaara, 1877, *Vainio* s.n. (TUR-V 8993 - lectotype (Mayrhofer 1984), TUR-V 9051 - isolectotype).

Exsiccata: Havaas: Lich. Norv. Exs. 442 (H), Krypt. Vind. 2287 (NY), Magnusson: Lich. Sel. Scand. 275 (H), Malme: Lich. Sue. 198 (H) and 874 (GZU), Obermayer: Dupla Graecensia Lich. 23 and 24 (GZU), Plantae Graecenses: Lich. 227 (GZU).

Description. Thallus thick, dark brown, usually discontinuous, consisting of tumid, irregular verrucae, matt. Thallus indeterminate, without perceptible hypothallus. Apothecia frequent, typically contiguous, broadly attached or sessile, born at all angles on the verrucae, to 0.60-1.00 mm diam.; disc black, more or less persistently plane; thalline margin concolorous with thallus, 0.05-0.10 mm wide, sometimes undeveloped or incomplete revealing proper margin, or entire, flexuose and persistent.

Amphithecium 55-90 μm wide laterally; cortex 5-10 μm wide laterally, sometimes with epicortex ca. 5 μm wide; 80-120 μm below, cortex ca. 10 μm wide. Peripheral cortical cells pigmented, to 5.0-6.5 μm wide; algal cells to 11.5-24.0 μm diam. Parathecium, hyaline or pigmented a shade of brown, 5-15 μm wide laterally, 20-40 μm wide above. Hypothecium hyaline to dark brown, 30-60 μm deep, sometimes extending into the medulla as a pigmented stipe. Hymenium 60-80 μm high; paraphyses 1.5-2.5 μm wide, apices expanded to 5.0-7.0 μm wide, heavily pigmented forming a dark brown epihymenium. Asci Bacidia-type, (33-40) x (14-17) μm; spores Beltraminia- (including Buellia-) type, 11.0-(13.1-13.7)-15.9, 13.4 x 6.9, 5.5-(6.7-7.1)-8.4 μm, locules filling cells, torus absent at all stages of development, walls ornamented (x1250). Conidiomata immersed, ostiole dark brown to black, <0.05 mm diam. Conidiophores Type III (according to Vobis 1980); conidia filiform and arcuate, 13.0-17.0 x 1.0 µm. Chemistry. Thalline reactions negative, no substances detected by TLC (see also Hecklau et al. 1981).

Ecology and distribution. Recorded on siliceous rocks, frequently on large boulders, particularly bird perches. Distributed across the northern hemisphere in northern regions (Figure 1).

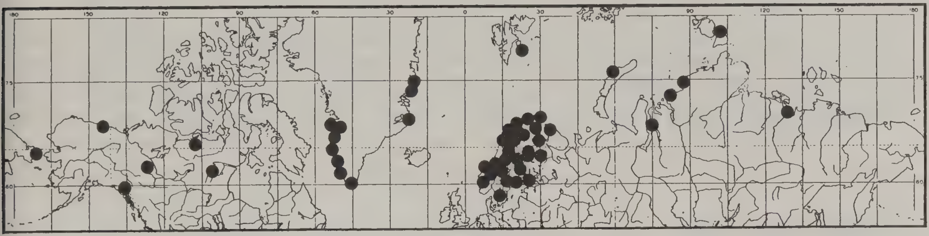

Figure 1. World distribution of *Amandinea cacuminum* based on examined specimens and literature sources from Andreev et al. (1996), Hansen (1984, 1993, 1995, 1997, 1998, 2000), Lynge (1940), Malme (1932), Thomson (1997), Zhurbenko (1996) and Zhurbenko & Hansen (1992).

The species was first reported from North America by Thomson (1979) from Alaska but this material is a *Buellia* (Sect. *Melanaspicilia*) species. However, the record of *Rinodina milvina* is based on a specimen of *A. cacuminum*.

Selected specimens not cited in earlier papers: CANADA. BRITISH COLUMBIA: Three Guardsman Pass, mi 60 Haines Hwy., *J.W. Thomson 21874* (WIS). U.S.A. ALASKA: Okpilak Lake, *J.W. Thomson 10226* (WIS). GREENLAND. DISKO: Disko Island, Godhavn,1982, *J. Poelt*, (GZU). SVALBARD. Edgeøya, Kapp Lee, Rosenbergdalen, 1986, *C.M. von Herk* (Aptroot, associated with *Rinodina balanina*). RUSSIA. NOVAYA ZEMLYA. Fughfiellet syd vor Arkhangel Bay, *B. Lynge* (C, associated with and curated under *Arctopeltis thuleana*); SIBERIA. Tumenskaja, Chugor-Yakha River, 3 km to NW from the mouth, *M. Andreev 912517* (UPS). SWEDEN. HÄLSINGLAND: Norrala, Stålnäset, *Å. Ågren 319* (UPS); LYCKSELE LAPPMARK: Stensele, Sandvik, 1934 *C. Stenholm* (GB); PITE LAPPMARK: Arjeplog, Peljekaisse, 1919, *C. Stenholm* (GB); VÄRMLAND: Lekvattnet, E of Nopikullen, *S.W. Sundell 8000* (UPS); VÄSTMANLAND: Götlunda, Valen in lake Hjälmaren just S of Östergården, *R. Moberg 6750* (UPS). FINLAND. NYLANDIA: Inkoo, *H. Mayrhofer 13.710* (GZU, H).

DISCUSSION

Amandinea cacuminum is a rather distinctive species characterized by the dark brown fragmented thallus consisting of tumid verrucae with erratically inserted apothecia. The spores have been compared by Degelius (1939) to those of *Rinodina pyrina* but the spores of this species possess septal wall thickenings during early developmental stages which are lacking in *A. cacuminum*.

The discovery of a pigmented hypothecium in a number of specimens, the filiform conidia and the fact that the thalline margin is frequently incomplete suggests that the species belongs in *Amandinea* rather than *Rinodina* where it has previously been placed. One specimen, Scotter 33154 (WIS), has relatively few lecanorine apothecia and intergrades continuously with adjacent lecideine apothecia when they become indistinguishable from those of *A. punctata* (Hoffm.) Coppins & Scheidegger except for thallus morphology and colour.

Ascal and molecular data confirm the need to transfer *Rinodina cacuminum* to *Amandinea*. Rambold et al. (1994) found the species to possess Bacidia-type asci characteristic of *Amandinea* species rather than Lecanora-type asci which define the genus *Rinodina*. Preliminary molecular results (Gert Helms, Göttingen, personal communication) also aligns the species with *Amandinea* rather than *Rinodina*.

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PSEUDOPAULIA TESSELLATA, A NEW GENUS AND SPECIES IN THE LICHINACEAE (LICHENIZED ASCOMYCOTINA) FROM SOCOTRA, YEMEN

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Abstract: The new genus *Pseudopaulia* is established in the cyanobacterial lichen family Lichinaceae (Lichinales, lichenized Ascomycotina). It is typified with *Pseudopaulia tessellata*. The thallus growth form and the thallus anatomy are distinctive. The new species grows on limestone boulders on Socotra (Yemen, Indian Ocean). Analyses of 18S rDNA data support a somewhat isolated systematic position in the Lichinaceae.

Introduction

Specimens of a small, blackish, squamulose, cyanobacterial lichen with a conspicuous thallus surface resembling that of tessellate *Paulia* species (Henssen 1986, Schultz et al. 1999) were collected during two trips to the Yemeni island of Socotra in 1994 (Dr. Bruno Mies) and 1997 (Dr. Bruno Mies and the author). Morphology and anatomy of the new species indicate that it is best placed in the Lichinaceae. The photobiont is a single-celled cyanobacterium; the thallus is homoiomerous, ecorticate and gelatinous when wet; the ascospores are simple and hyaline, the ascus is prototunicate and the pycnidia and conidia belong to the type typically observed in the family. However, the species does not fit into any of the known genera of the Lichinaceae due to its peculiar thallus growth combined with a paraplectenchymatous thallus anatomy. Later, 18S rDNA sequence analyses clearly confirmed the placement of the taxon (referred to as "Lichinaceae gen. spec.") within the family (Schultz 2000). The species clustered next to a clade supporting *Lichina pygmaea* (Lightf.) Agardh and *L. confinis* (O.F. Müller) Agardh. However, it differs from *Lichina* in numerous characters such as thallus growth form, thallus anatomy, ecology and the type of photobiont. To accommodate the new species the genus *Pseudopaulia* gen. nov., typified with *P. tessellata* sp. nov., is described here.

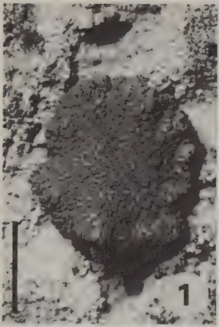
Material and methods

The following selected specimens were used for comparative microscopic studies: ***Metamelanea melambola*** (Tuck.) Henssen: VENEZUELA: Edo. Bolívar, c. 60 km SW of Cd. Bolívar, granite inselberg, c. 07°45'N, 63°50'W, May 1996, *B. Büdel* 24039d & *M. Schultz* (herb. Büdel). - ***Paulia gibbosa*** Henssen: VENEZUELA: Edo. Amazonas, Pto. Ayacucho, granite inselberg, c. 05°40'N, 67°40'W, May 1996, *B. Büdel* 24046b, 24057b, 24110a & *M. Schultz* (herb. Büdel). - ***Paulia myriocarpa*** (Zahlbr.) Henssen: YEMEN: Socotra, "Momi" plateau, limestone, c. 450 m, 12°31.3'N, 54°19.0'E, 22.03.1997, *M. Schultz* 14060e (herb. Schultz). - ***Phylliscidium monophyllum*** (Krempelh.) Forss.: VENEZUELA: Edo. Amazonas, Pto. Ayacucho, granite inselberg, c. 05°40'N, 67°40'W, May 1996, *B. Büdel* 24046c & *M. Schultz* (herb. Büdel). - ***Phylliscum demangeonii*** (Moug. & Mont. in Mont.) Nyl.: USA: Minnesota, July 1979, *C.M. Wetmore* 39043 (MIN). - ***Psorotichia diffracta*** (Nyl.) Forss.: YEMEN: Socotra, c. 3.5 km S of Hadibu, foothills of Haghier Mts., c. 100 m, 12°37.3'N, 54°1.0'E, 19.03.1997, *M. Schultz* 14043c (herb. Schultz). - ***Pterygiopsis guyanensis*** M. Schultz, Porembski & Büdel: GUYANA: Shea Rock, granite inselberg, 1997, *F. Scheplitz* (B, holotype) - ***Pterygiopsis submersa*** Büdel, Henssen & Wessels: REP. SOUTH AFRICA: Transvaal, Dokolewa Valley, 22.09.1983, *B. Büdel* 14036a & *D.C.J. Wessels* (herb. Büdel). - ***Stromatella bermudana*** (Riddle) Henssen: USA: Arizona, Yavapai Co., E of Camp Verde, limestone, c. 1000 m, 111°49'W, 34°33'N, 21.02.1999, *M. Schultz* 16055f (herb. Schultz).

Cryotome sections (c. 20 µm thick) were stained with lactophenol cotton blue. Anatomical measurements were made using semi-permanent mounts. The iodine reaction was tested after pretreatment with KOH. Micrographs were taken with a Zeiss (Jena) Axioskop using differential interference contrast (DIC). Macrographs were taken using a Nikon F3 camera with a Zeiss (Jena) Luminar 40 mm lens mounted on bellows.

For molecular techniques used to study the new species refer to Schultz (2000) and Schultz et al. (2001). A maximum parsimony analysis (heuristic search, stepwise and 500 randon addition sequences) and a distance analysis (neighbor joining, Log/Det paralinear parameter) were performed using PAUP (Swofford 2000). Bootstrap analyses were performed with 500 replicates. Specimens of the following taxa (accession numbers given in brackets) were included in the data matrix (alignment given in Schultz 2000): ***Anema nummularium*** (Duf. ex Dur. & Mont.) Nyl. ex Forss. (AF226888), ***Digitothyrea divergens*** (Henssen) P. Moreno & Egea (AF336989, AF336890), ***D. polyglossa*** (Nyl.) P. Moreno & Egea (AF336891), ***Ephebe brasiliensis*** (Vain.) Henssen (AF336892), ***Heppia adglutinata*** (Krempelh.) A. Massal. (AF336893), ***H. conchiloba*** Zahlbr. (AF282908), ***H. despreauxii*** (Mont.) Tuck. (AF336894), ***Jenmania goebelii*** Wächter (AF336895), *Lempholemma* spec. (AF336896), ***Lichina confinis*** (O.F. Müller) Agardh (AF336897), ***L. pygmaea*** (Lightf.) Agardh (AF282909), ***Lichinella cribellifera*** (Nyl.) P. Moreno & Egea (AF282910), ***Paulia aldabrensis*** Henssen (AF282911), ***P. caespitosa*** Tretiach & Henssen (AF336899), ***P. perforata*** (Pers.) Asah. (AF336900), ***Peccania arizonica*** Tuck. ex Herre (AF336901), ***P. coralloides*** (A. Massal.) A. Massal. (AF282912), ***P. fontqueriana*** P. Moreno & Egea (AF336902), ***Peltula obscurans*** (Nyl.) Gyeln. var. ***hassei*** (Zahlbr.) Wetm. (AF282913), ***P. radicata*** Nyl. (AF336903), ***Phloeopeccania pulvinulina*** J. Steiner (AF336904), ***Pseudopaulia tessellata*** M. Schultz (AF336898), ***Psorotichia murorum*** A. Massal. (AF336905), ***P. polyspora*** M. Schultz & Büdel (AF336906), ***P. schaereri*** (A. Massal.) Arn. (AF336907), ***Pterygiopsis guyanensis*** M. Schultz, Porembski & Büdel (AF282914), ***Pyrenopsis*** spec. (AF338236), ***Stromatella bermudana*** (Riddle) Henssen (AF336908), ***Thyrea confusa*** Henssen (AF282915) and ***T. pachyphylla*** (Müll. Arg.) Henssen (AF336909).

Figures 1 & 2: *Paulia myriocarpa*, Schultz 14060e. **1)** Thallus rosette-shaped, surface tessellate. **2)** Hyphae loosely reticulate, photobiont cells large. **Figures 3-9:** *Pseudopaulia tessellata.* **3)** Thallus section: lobules densely aggregated, tips imbricate (arrow) (holotype). **4 & 5)** Thallus surface irregularly tessellate, margin crenate (arrow), apothecia small (arrow), (isotype). **6)** Hymenium: ascospores (arrow), paraphyses (holotype). **7)** Pycnidium: ellipsoid conidia, simple conidiophores; thallus anatomy paraplectenchymatous, symbiont cells small (holotype). **8 & 9)** Hymenium: asci cylindrical, paraphyses, true exciple (arrow) (holotype). Scale bar: figs. **1, 4 & 5** = 2 mm; figs. **2 & 6-8** = 50 µm; fig. **3** = 250 µm; fig. **9** = 100 µm.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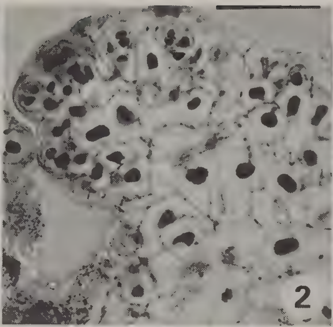
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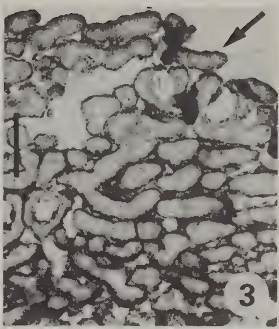
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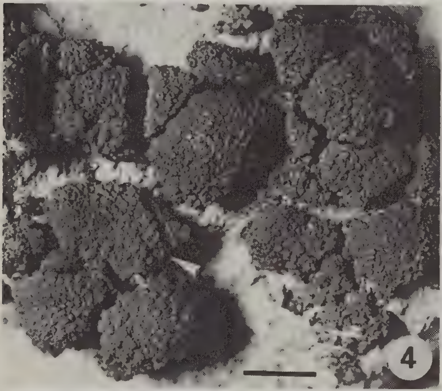
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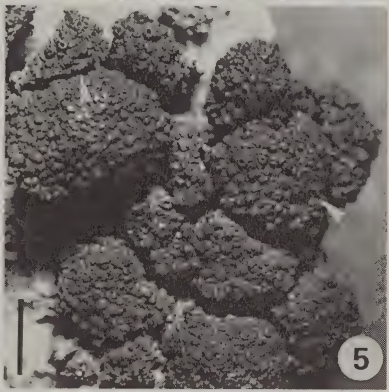
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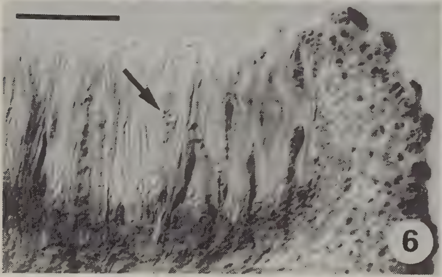
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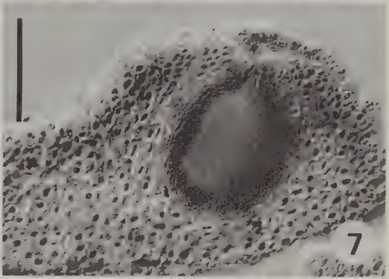
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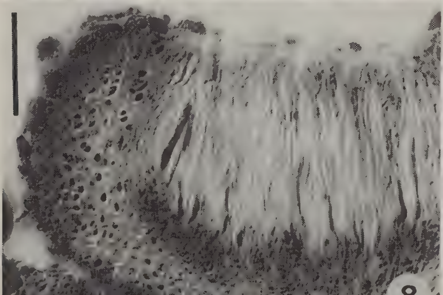
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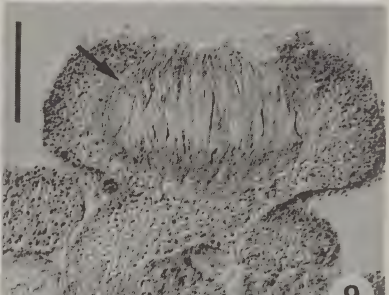
9

The Genus

Pseudopaulia M. Schultz gen. nov.

Genus ad familiam Lichinaceam pertinens. Thallus nigricans, squamulosus, homoiomerus, gelatinosus, paraplectenchymatus, ecorticatus. Algae ad ordinem Chroococcales pertinentes. Apothecia nigrescentes, discus apertus, margo thallinus distinctus, excipulum proprium hyalinum, distinctum. Hymenium in iodo caerulescens. Paraphyses simplices vel ramosae. Asci octospori, cylindracei ad anguste clavati, leptodermati. Ascosporae hyalinae, eseptatae, ellipsoidae vel subglobosae. Pycnidia immersa, conidia ellipsoidea vel bacillaria.

Typus generis: *Pseudopaulia tessellata* M. Schultz

Thallus blackish, gelatinous, squamulose; homoiomerous, paraplectenchymatous, ecorticate. *Photobiont* a unicellular cyanobacterium. *Apothecia* dark, open and plane at maturity; apothecial margin zeorine, thalline exciple thin, smooth. *Excipulum proprium* thin, hyaline. *Hymenium* IKI+ blue. *Paraphyses* straight, sparsely branched and anastomosing. *Asci* cylindrical to narrowly clavate, prototunicate. *Ascospores* 8, simple, hyaline. *Pycnidia* immersed, simple, wall hyaline, thin; *conidia* ellipsoid or bacilliform, small.

Etymology: The generic name refers to *Paulia*, a genus of the Lichinaceae with similar thallus growth forms, but with a different thallus anatomy.

The species

Pseudopaulia tessellata M. Schultz sp. nov.

Thallus nigricans, gelatinosus, squamulosus, rosulatus, tessellatus vel imbricatus, planus vel convexus. Squamulis parvis, usque ad 5 mm latis, usque ad 5 mm altis. Thallus homoiomerus, ecorticatus, paraplectenchymatus. Cellulis hypharum parvis, 2.5-5 × 5 µm latis, globosis vel angulatis. Algae ad ordinem Chroococcales pertinentes, tunica gelatinosa leptodermàtica. Apothecia semi-sessilia, discus planus, margo thallinus distinctus, tenuis, excipulum proprium distinctum, hyalinum, tenuis. Hymenium hyalinum, in iodo caerulescens. Paraphyses graciles, simplices vel ramosae. Asci octospori, cylindracei ad anguste clavati, in iodo non tincti, leptodermati. Ascosporae eseptatae, hyalinae, ellipsoideae vel subglobosae, parvae, 7.5-10 × 5-7.5 µm. Pycnidia immersa, 50-75 × 75 µm, conidia ellipsoidea vel bacillaria, 2.5 × 1 µm.

Typus: Yemen: Socotra Island, c. 3.5 km S of Hadibu, foot of Haghier Mts., limestone boulder, c. 100 m, 12°37.3'N, 54°1.0'E, 19.03.1997, *M. Schultz* 14042a (B-holotype; B & herb. M. Schultz-isotypes).

Thallus: Blackish, rarely slightly pruinose, gelatinous when wet; squamulose, irregularly rosette-shaped (Figs. 4 & 5); thallus surface dull, irregularly tessellate (Figs. 4 & 5). *Squamules* ± flat to bulging with age, 0.5-5 mm wide, up to 5 mm high; margins crenate (Figs. 4 & 5); squamules formed by densely aggregated tufts or fascicles of thin lobules; tufts constricted at the base to form an “umbilicus” or “stalk”. *Lobules* 0.075-0.1 mm wide, branched, ± vertically arranged and dying from the base, marginal lobules bent to slightly revolute, tips of the lobules imbricately arranged (Fig. 3). Thallus homoiomerous, ecorticate, paraplectenchymatous (Fig. 7); composed of angular hyphal cells, 2.5-5 × 5 µm. *Photobiont* a unicellular cyanobacterium (Chroococcales); cells globose, (3-)5-7.5 µm wide without sheath, 5-12.5 µm wide including sheath;

gelatinous sheath thin, yellowish-brown (KOH-), indistinctly layered, becoming hyaline towards the thallus centre.

Apothecia: 1 to 5(-10) per squamule (Figs. 4 & 5), small, up to 0.35 mm wide, semi-immersed; thalline margin thin, 25-50 µm wide, smooth; apothecial disc punctiform, later open, flat, dark yellowish to reddish brown when dry, slightly lighter when wet. *Exciple* (Figs. 8 & 9) thin, 5-7.5 µm wide, hyaline. *Hymenium* (Figs. 6 & 8) hyaline, 100-125 µm high, IKI+ faintly blue. *Subhymenium* hyaline, c. 25 µm high, IKI+ faintly blue. *Paraphyses* (Fig. 6) straight, sparsely branched and anastomosing, cells slender, 5-10 × 2 µm wide, apical cells slightly thickened. *Asci* (Figs. 8 & 9) cylindrical to narrowly clavate, up to 75 × 5-7.5 µm; ascus wall thin throughout, IKI-, prototunicate, opening by apical ruptures. *Ascospores* 8, simple, hyaline, broad ellipsoid to subglobose, 7.5-10 × 5-7.5 µm; spore wall thin or finally thick (Fig. 6).

Ascoma ontogeny: In spite of the richly fertile and diverse material available for ontogenetic studies, no ascoma initials have been observed so far.

Pycnidia: Immersed, pyriform, 50-75 × 75 µm wide (Fig. 7), finally c. 0.1 mm wide, belonging to type I (Vobis 1980); wall simple, hyaline; ostiolum hyaline. *Conidia* simple, hyaline, ellipsoid or bacilliform, 2.5 × 1 µm (Fig. 7); conidiophores elongate, simple, belonging to type II (Vobis 1980).

Etymology: The species name refers to the remarkable composition of the thallus squamules with densely packed lobules having imbricate tips.

Ecology and Distribution: Pseudopaulia tessellata is currently known from the type locality and similar sites on Socotra. It colonizes open, inclined faces of dry, karstic limestone boulders. The species is accompanied by other cyanobacterial lichens such as *Collema multipartitum* Sm., *Peltula* spp., *Paulia perforata*, *Lempholemma socotranum* Schultz ined. and free-living cyanobacteria such as *Scytonema*.

Notes: Pseudopaulia tessellata resembles other tessellate members of the Lichinaceae such as *Paulia myriocarpa* (Fig. 1), *P. gibbosa*, *P. schroederi*, *Phyllisciella* spp. and *Phylliscum* spp. (Henssen & Büdel 1984). A finely tessellate thallus surface is also present in the crustose-squamulose lichen *Stromatella bermudana* (Riddle) Henssen (Henssen 1989). *Paulia*, *Phyllisciella* and *Phylliscum* differ from *Pseudopaulia* in the loosely reticulate thallus anatomy with thin, elongated fungal cells surrounding large photobiont cells (Fig. 2). A ± paraplectenchymatous thallus anatomy is present in *Stromatella*, *Metamelanea* and *Psorotichia*. However, *Stromatella* and *Metamelanea* differ in apothecial features and *Psorotichia* contains exclusively crustose species. *Pseudopaulia* could also be related to *Pterygiopsis*. However, the genus *Pterygiopsis* as currently used is quite polymorphic and should probably be divided into smaller unities (Schultz 2000).

In order to look for the phylogenetic relationships of *Pseudopaulia tessellata* molecular data have also been used. According to 18S rDNA analyses (Schultz 2000) *Pseudopaulia tessellata* is the sister group of *Lichina pygmaea* and *L. confinis*. However, no morphological or anatomical features which support this relationship have been observed. One possible explanation would be if other closely related species of both *Pseudopaulia* and *Lichina* exist, but have not yet been discovered. Alternatively, there could be relationships of *Lichina* and *Pseudopaulia* with other species of the Lichinaceae which have not yet been included in molecular analyses; or these relationships are not displayed in the gene studied. Furthermore, the clade supporting *Lichina* is the longest in the entire tree and therefore, long branch attraction should be considered. Judging from the growth habit or the thallus anatomy, *Paulia*, *Psorotichia*, *Pterygiopsis*, *Stromatella* or even *Peccania arizonica* Tuck. ex Herre were expected to be close relatives of *Pseudopaulia tessellata*. However, 18S rDNA analyses suggest a different phylogeny (Schultz 2000) (Fig. 10) with none of the above taxa being closely related to *Pseudopaulia tessellata*. Future taxonomic and systematic studies including the analysis other genes are therefore necessary to elucidate the phylogenetic relationships of the new genus and species.

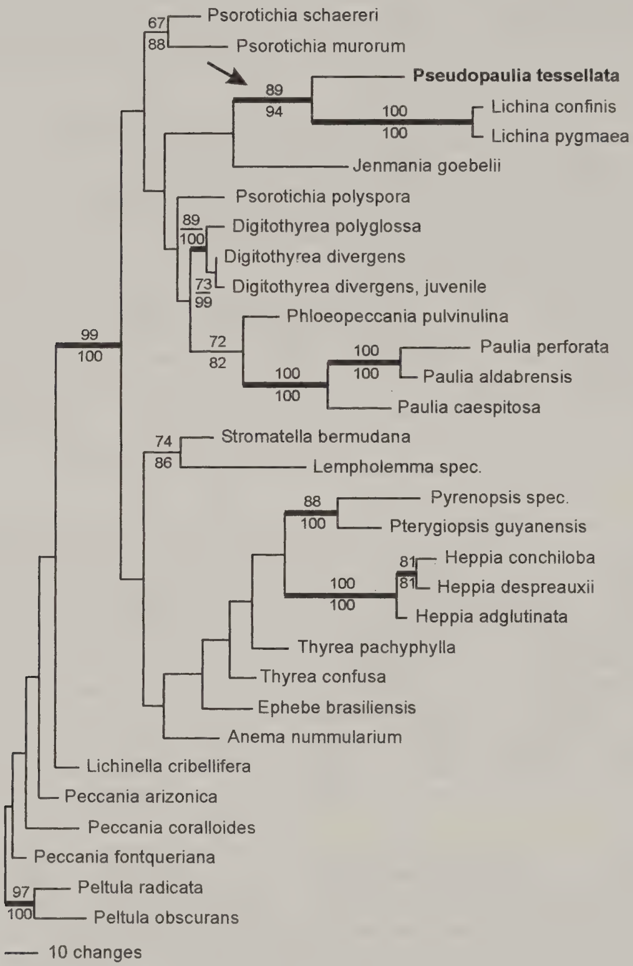
67
88
Psorotichia schaereri
Psorotichia murorum
89
94
Pseudopaulia tessellata
100
100
Lichina confinis
Lichina pygmaea
Jenmania goebelii
Psorotichia polyspora
89
100
Digitothyrea polyglossa
Digitothyrea divergens
73
99
Digitothyrea divergens, juvenile
Phloeopeccania pulvinulina
99
100
72
82
100
100
Paulia perforata
100
100
Paulia aldabrensis
Paulia caespitosa
74
86
Stromatella bermudana
Lempholemma spec.
88
100
Pyrenopsis spec.
Pterygiopsis guyanensis
81
81
Heppia conchiloba
100
100
Heppia despreauxii
Heppia adglutinata
Thyrea pachyphylla
Thyrea confusa
Ephebe brasiliensis
Anema nummularium
Lichinella cribellifera
Peccania arizonica
Peccania coralloides
Peccania fontqueriana
97
100
Peltula radicata
Peltula obscurans
10 changes

Fig. 10: Phylogenetic relationships of *Pseudopaulia tessellata* inferred from 18S rDNA sequence data. One of two equally most parsimonious trees obtained by maximum parsimony analysis. Upper figures are bootstrap values after 500 replicates in the parsimony analysis; lower figures are bootstrap values after 500 replicates of a neighbor joining analysis. Note the dubious sister group relationship to *Lichina*.

Additional specimens: YEMEN, Socotra Island, wadi Ayeb, 5 km SW of Hadibu, in limestone clefts, 300 m, 19.01.1994, *B. Mies & C. Printzen* (B. Mies 12989); wadi Ma'nifoh, c. 4 km S of Hadibu, foot of Haghier Mts., on bare limestone, c. 50 m, 12°37'N, 54°1.1'E, 18.03.1997, *B. Mies* 722 (M. Schultz 14041b); c. 4.5 km S of Hadibu, ascent to Muqadrihon Pass, limestone boulder, c. 250 m, 12°36.8'N, 54°0.75'E, 19.03.1997, *M. Schultz* 14046c (M. Schultz).

Acknowledgements

This study was funded by DAAD (Deutscher Akademischer Austauschdienst) and DFG (Deutsche Forschungsgemeinschaft) (Bu 666/8-1). I thank Dr. Bruno Mies (Duisburg) for loaning his material, Prof. Burkhard Büdel (Kaiserslautern) and Dr. Wolfgang Wranik (Rostock) for supporting my DAAD application and Dr. Abdul Nasser Al-Gifri (Aden) for his hospitality and help.

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MYCOTAXON

Volume LXXXII, pp. 451 April-June 2002

A NEW NAME FOR SPORIDESMIUM FUSCUM GULIS & MARVANOVÁ

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After publication of *Sporidesmium fuscum* Gulis & Marvanová (1999), Dr. J. David (CABI Bioscience, UK) kindly notified us that we created a homonym. Therefore, a new name for our species is presented here.

Sporidesmium subfuscum Marvanová & Gulis nom. nov.
Etym.: *sub-* (Lat.) = less than and *fuscum* (Lat.) = pale brown, fuscous.

≡ *Sporidesmium fuscum* Gulis & Marvanová, Mycotaxon **72**: 242, 1999 (nom. illeg., International Code of Botanical Nomenclature 2000, Art. 53.1); non *Sporidesmium fuscum* Bonord., Handb. allgem. Mykol. p. 48, 1851.

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MYCOTAXON

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TRECHISPORA ANTIPUS SP. NOV., UNE SECONDE ESPÈCE BISPORIQUE DU GENRE TRECHISPORA (BASIDIOMYCOTA, STEREALES)

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Résumé. *Trechispora antipus* Trichies & Schultheis sp. nov., une espèce munie de basides bisporiques, est décrite de France. Elle se distingue de l'unique autre taxon bisporique du genre, l'espèce australienne *T. bispora*, par la taille et l'ornementation des spores.

Zusammenfassung. *Trechispora antipus* Trichies & Schultheis sp. nov., eine Art mit zweisporigen Basidien, wird aus Frankreich beschrieben. Die Art unterscheidet sich von der australischen *T. bispora*, der einzigen anderen bekannten Art der Gattung mit zweizelligen Basidien, durch die Grösse und die Ornamentation der Sporen.

Abstract. *Trechispora antipus* Trichies & Schultheis sp. nov., a species with two-spored basidia, is described from France. It is distinguished from the only hitherto known bisporic species of the genus, the Australian *T. bispora*, by the size and the ornamentation of the spores.

Trechispora antipus Trichies & Schultheis, sp. nov.

Basidiomata resupinata, effusa, tenuia, pellicularia, laevia, adhaerentia; rhizomorphae adsunt; margo indeterminatus aut breviter fibrillosus; systema hyphale monomiticum; hyphae tenuitunicatae, fibulatae: in subhymenio (1,8-)2-3(-4) µm diam., in rhizomorphis subiculoque (1-)1,5-5 µm diam., inflatae usque ad 6-7(-8,5) µm prope quaedam septa, interdum crystallis haud propriis praeditae; basidia fibulata, ovoidea aut paulum urniformia 8-15 x 4,5-5,5(-6) µm, sterigmata (1-)2, leviter curvata, 6-8 µm longa; sporae ellipsoideae, haud crebre echinulatae, adaxiali parte saepe laevi, 3,8-4,3(-4,6) x (2,5-)2,7-3(-3,2) µm, echinulis circiter 0,5-0,8 µm prominentibus. A simili *Trechispora bispora* (Warcup & Talbot) Liberta differt praecipue sporis minoribus et aliusmodi ornatis.

Holotypus. France, Loire, Montbrison, Champs, au bord de l'étang Le Perrin, 31 oct. 2000, sur tiges mortes gisantes de *Phragmites australis*, 31 oct. 2000, B. Schultheis 310/00 (K – holotype; hb. Schultheis, hb. Trichies GT 01052 – isotypes).

Etymologie. L'épithète a été choisie pour évoquer la localisation géographique originelle de cette espèce, située à l'antipode de son homologue austral, *Trechispora bispora*.

Ilustrations. Figs. 1-3.

Basidiome résupiné, pelliculaire, très adhérent, lisse, aranéeux s.l., blanc, même en herbier, mince (50 à 200 µm), en plages arrondies discontinues ou confluentes; marge indifférenciée ou courtement fibrilleuse à fimbriée; de fins faisceaux rhizomorphiques s'observent sur et sous le basidiome ou bien courent sur le substrat. *Structure hyphale* monomitique; toutes les hyphes sont à paroi fine et à boucles constantes: les sous-hyméniales mesurent (1,8-)2-3(-4) µm en diam.; les basales et celles des cordons, de (1-)1,5-5 µm, sont munies, à certaines cloisons, des renflements typiques du genre *Trechispora* qui atteignent 6-7(-8,5) µm de diam.; surtout dans les parties les plus anciennes, ces hyphes sont encombrées de cristaux d'oxolate de calcium à la forme peu caractérisée, globuleuse ou allongée-prismatique. *Basides* de morphologie variable; les unes sont trapues, ovoïdales à courtement claviformes, les autres, plus élancées, sont pourvues d'une ou (rarement) de deux constrictions médianes qui leur confèrent une silhouette urniforme; elles naissent souvent d'un court rameau perpendiculaire à l'hyphe sous-hyméniale et mesurent 8-15 x 4,5-5,5(-6) µm; elles portent (1-)2 stérigmates légèrement arqués de 6 à 8 µm, donc relativement longs en regard de la taille des basides. Boucle basale toujours présente. *Spores* ellipsoïdales, hyalines, à paroi fine, à face adaxiale presque plane et paraissant généralement lisse, 3,8-4,3(-4,6) x (2,5-)2,7-3(-3,2) µm, hérissées d'environ 11 à 15 verrues coniques, à sommet émoussé, hautes de 0,5-0,8 µm; apicule proéminent, de 0,8-1(-1,2) µm.

Observations. Au sein du genre *Trechispora* P. Karst. 1890, une seule autre espèce bisporique a été publiée à ce jour. Il s'agit de *T. bispora* (Warcup & Talbot) Liberta (= *Cristella bispora* Warcup & Talbot), un taxon qui n'est connu que du matériel originel australien (Warcup & Talbot 1962, Liberta 1973). Cette stricte localisation est confirmée par Hjortstam et al. (1988) et par Gilles (1994) qui n'en signalent aucune récolte européenne. K. H. Larsson (comm. pers.) n'a pas pu examiner le matériel holotype et ne connaît aucune autre espèce bisporique dans le genre. La nouvelle espèce est très voisine de *T. bispora*. Ainsi leurs basidiomes sont d'un aspect similaire, leurs hyphes sont très semblables, y compris en ce qui concerne leurs dilatations et leurs incrustations, leurs basides présentent une forme et des dimensions à peu près analogues. En outre, les deux espèces semblent partager une même appétence pour les chaumes de *Poaceae* (*Triticum* sp. pour l'une, *Phragmites australis*, pour l'autre). Notons, toutefois, que l'espèce australe a été récoltée dans un champ cultivé, après le labour, alors que son homologue boréale a été trouvé dans un milieu plutôt hygrophile.

Les deux espèces se distinguent cependant nettement au niveau des spores et des stérigmates. Les spores de *T. bispora* sont nettement plus grandes. Les dimensions données dans la description originale (Warcup & Talbot 1962) sont de 6-6,5 x 4,2-4,5 µm, mais elles comprennent les verrues. En réduisant ces chiffres de la hauteur maximale de l'ornementation (deux fois 0,5 µm) pour une comparaison plus objective, les données

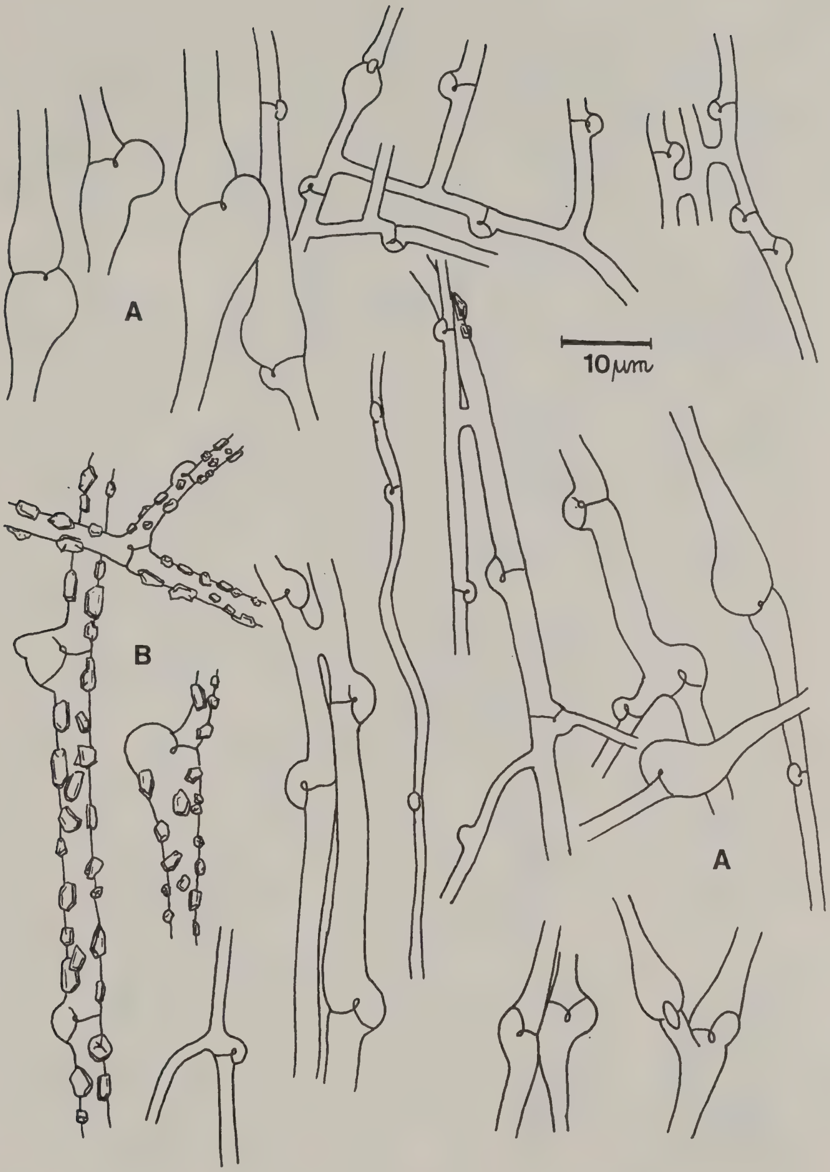

Fig. 1. *Trechispora antipus* sp. nov. (holotype), hyphes basales. A: renflements ampullacés; B: hyphes incrustées.

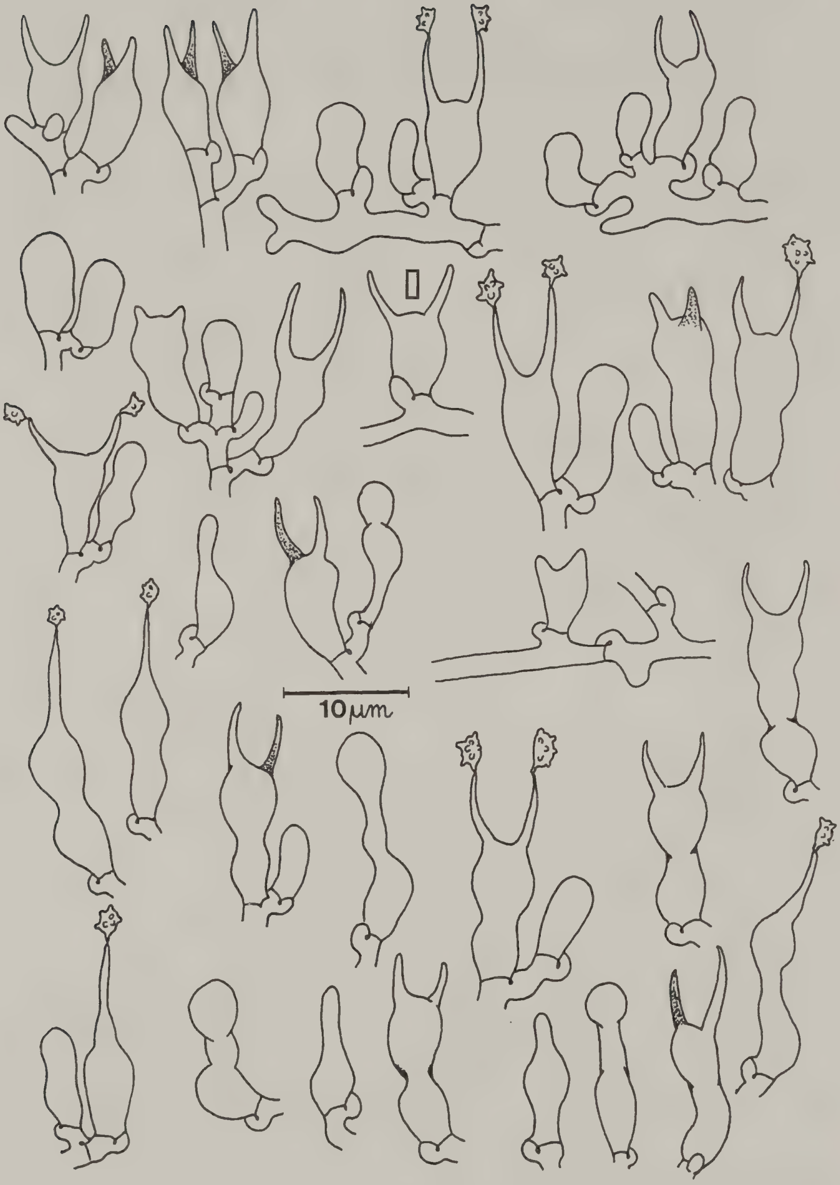

Fig. 2. *Trechispora antipus* sp. nov. (holotype), basides.

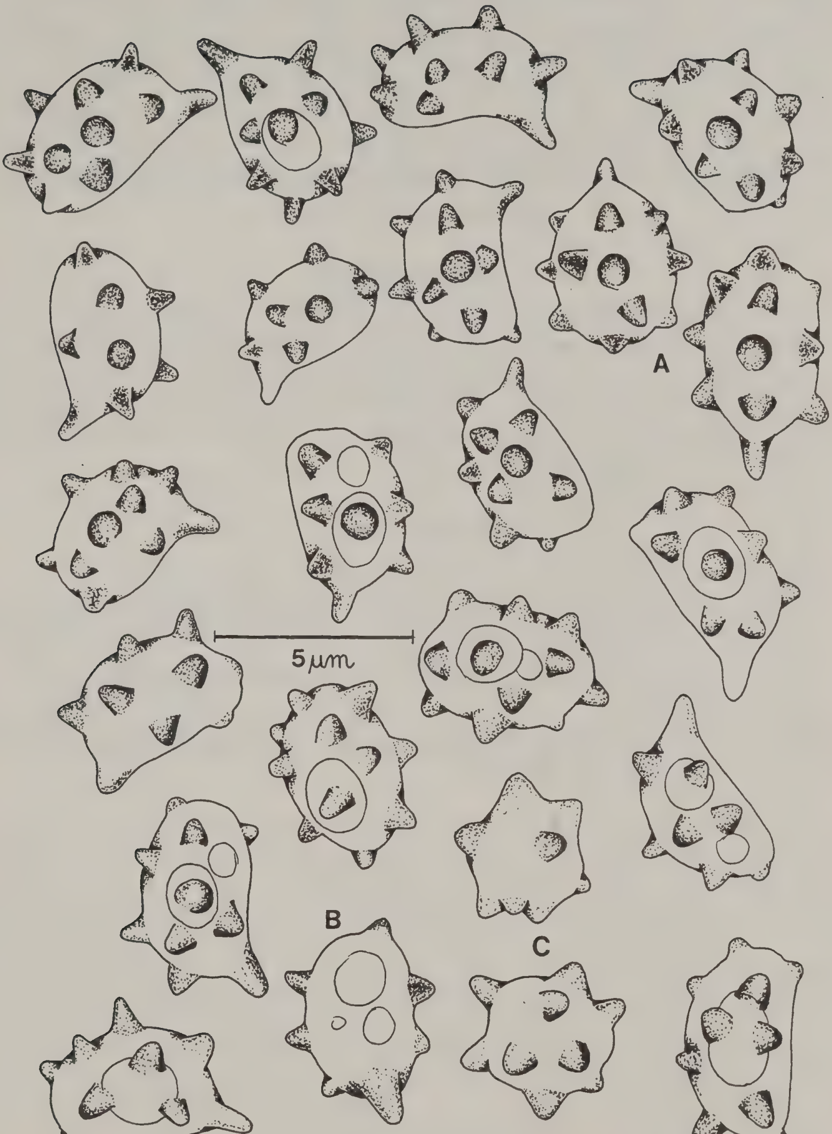

Fig. 3. *Trechispora antipus* sp. nov. (holotype), spores (sur sporée) en diverses positions. A: face dorsale; B: face ventrale; C: vue polaire.

obtenues demeurent obstinément supérieures aux dimensions des spores de *T. antipus*. D'autre part, les stérigmates sont environ deux fois plus longs chez *T. antipus* que chez *T. bispora* (respectivement 6-8 µm, contre 3(-5) µm). Toutefois, la dualité de ces deux taxons se révèle surtout, à notre sens, dans l'aspect de leur ornementation sporale, que l'on considère la forme, la hauteur ou la densité de ces émergences. *T. bispora* produit des spores fortement échinulées ou aspérulées par d'abondantes épines atteignant 0,5 µm. Celles de *T. antipus*, au contraire, portent des ornements coniques, très clairsemés et presque absents de leur face ventrale; ils sont en outre distinctement plus hauts que chez *T. bispora*.

Remerciements

Nous voudrions remercier chaleureusement K. H. Larsson de Göteborg, pour son obligeance à nous fournir les informations sollicitées, Jacques Boidin de Lyon et Paul Diederich de Luxembourg pour leur lecture critique de ce manuscrit, Marc Lilbert de Vandoeuvre pour la traduction latine de la description. Le deuxième auteur est particulièrement reconnaissant, pour son soutien permanent à Norbert Stomp, directeur du Musée national d'histoire naturelle au Luxembourg.

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PHACELLIUM STEPHANANDRICOLA SP. NOV. ON STEPHANANDRA

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ABSTRACT: *Phacellium stephanandricola* sp. nov., associated with leaf spots of *Stephanandra incisa* Zabel from Korea is described, illustrated and compared with *Pseudocercospora stephanandrae* and *Phacellium sessile*.

Keywords: mycoflora, cercosporoid fungus, leaf spots, Korea

In the course of extensive taxonomic studies for a critical revision of the local records of *Cercospora* spp. and taxa of allied genera from Korea (Shin and Kim, 2001), a cercosporoid fungus associated with leaf spots of *Stephanandra incisa* Zabel was determined to be an undescribed species of *Phacellium* Bonord. sensu Braun (1988, 1998). This new species is described, illustrated, discussed and compared with *Pseudocercospora stephanandrae* (Tak. Kobay. & H. Horie) Nakashima & Tak. Kobay. (2000), recorded on leaves of the same host plant from Japan, as well as with the similar fungus *Phacellium sessile* U. Braun on *Sanguisorba canadensis* L. belonging to the family Rosaceae (see Braun, 1998).

***Phacellium stephanandricola* H.D. Shin & J.D. Kim**, sp. nov. (Fig. 1)

Maculae amphigenae, discretae, distinctae, angulares vel irregulares, plerumque per venas limitatae, 0.5-3 mm diam., vel confluentes et usque 6 mm latae, in epiphyllo brunneae vel pallide brunneae, in hypophyllo griseo-brunneae. Conidiomata hypophylla, synnematalia, solitaria, dilute olivacea. Mycelium immersum; hyphae septatae, ramosae, hyalinae vel dilutissime olivaceae. Synnemata erecta, ex stromatibus oriunda, per stoma vel interdum per cuticulam emergentia, 85-390×15-40 μm, primo laxa, deinde dense aggregata, subcylindrica, ad basim brunnea vel olivaceo-brunnea, apicem versus pallidiora, interdum omnino pigmentosa; conidiophora 2-4 μm lata, 3-7-septata, simplicia vel 1-3-ramosa; cellulae conidiogenae, integratae, terminales et pleurogenae, rectae vel interdum sinuosae, apice geniculato, hyalinae; cicatrices conidiales conspicuae, minutae, incrassatae, fuscatae. Conidia solitaria, catenata vel ramicatenata, cylindrica vel ellipsoidea, leniter fusiformia, recta, hyalina, aseptata vel 1-3-septata, ad septum non constricta, parum verruculosa, ad basim obtusa vel subtruncata, apice obtuso vel subobtuso, 5-36×2.0-4.5 μm; hila paulo incrassata, leniter fuscata, non eminentia.

Leaf spots amphigenous, scattered, distinct, angular to irregular, usually vein-limited, 0.5-3 mm diam., up to 6 mm when coalescent, initially effuse, discolored to greenish yellow, later forming greenish brown to pale brown spots with olivaceous-green halo on the upper surface; at first appearing grayish discolored, later turning grayish brown with indefinite margin or faintly whitish halo, finally becoming somewhat velvety to cottony due to scattered blackish dots caused by the fungal fructification on the lower leaf surface. Conidiomata hypophyllous, synnematous, solitary, pale to somewhat pigmented. Mycelium internal; hyphae septate, branched, hyaline to faintly pigmented. Synnemata erect, arising from stromata, emerging through stomata or through the cuticle, 85-390×15-40 μm, at first rather loose, but later densely aggregated, forming firm stalks, subcylindrical, composed of numerous compact parallel conidiophores, apically splaying out, olivaceous-brown to brown at the base, paler towards the apex, sometimes pigmented almost throughout; individual conidiophores 2-4 μm wide, 3-7-septate, simple or with up to 3 branches; conidiogenous cells terminal as well as pleurogenous, almost straight to partly sinuous, geniculate at the apex, hyaline or almost so; conidial scars conspicuous, small, thickened and darkened, apical and on small shoulders of conidiogenous cells caused by geniculation. Conidia solitary, catenate, sometimes in short branched chains, cylindrical to ellipsoidal or fusiform, straight, hyaline, mostly aseptate or uniseptate, occasionally up to 3-septate, non-constricted at the septa, somewhat verruculose, obtuse to subtruncate at the base, obtuse to subobtuse at the apex, 5-36×2.0-4.5 μm; hilum slightly thickened, somewhat darkened, and non-protuberant.

Holotypus: On living leaves of *Stephanandra incisa* Zabel [Rosaceae], Seoul, S. Korea, Shin, 6 VI 2000 (SMK 17409).
Isotypus: HAL 1656.
Additional specimens examined: SMK 18236 (19 VII 2001, Pochon), 18456 (17 IX 2001, Hongchon).

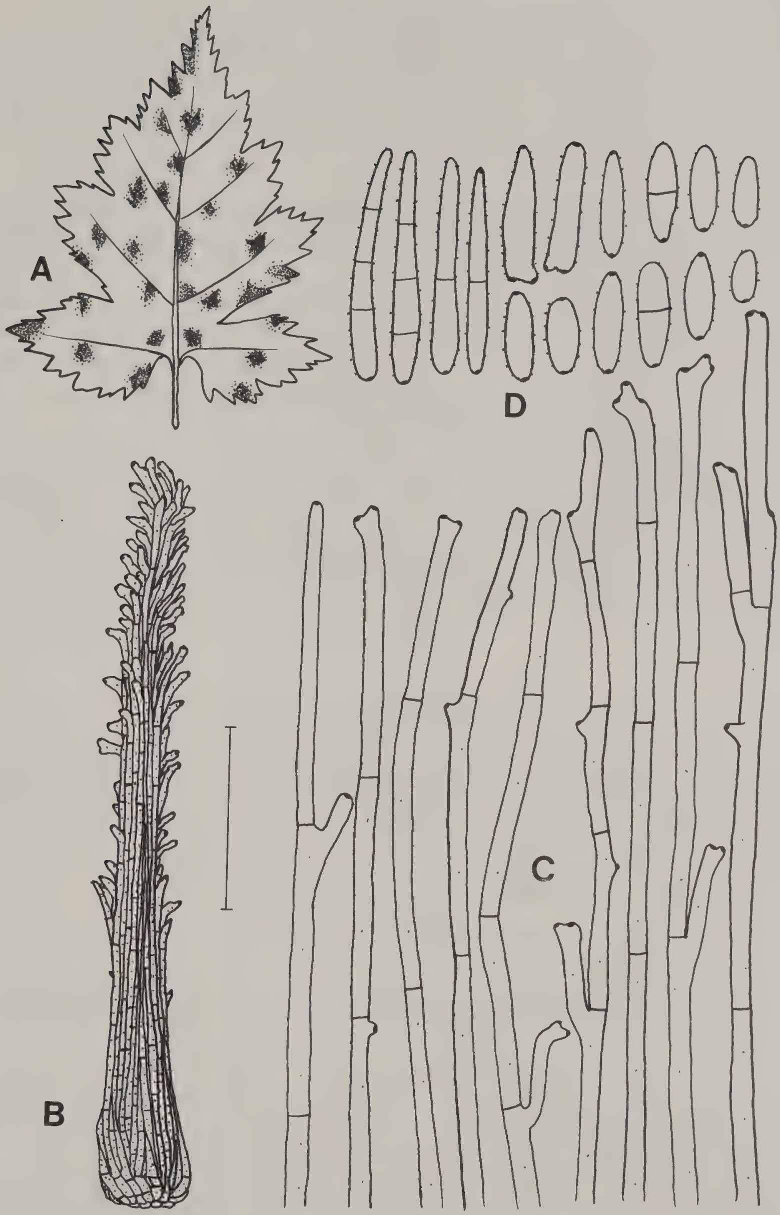

Fig. 1. *Phacellium stephanandricola* H.D. Shin & J.D. Kim: **A**, Leaf spots on the lower leaf surface of *Stephanandra incisa* (0.8×). **B**, Synnematous conidiophores. **C**, Upper portion of conidiophores, **D**, Conidia. Scale bar represents 75 µm for B and 30 µm for C & D.

Note: Only a single cercosporoid species, *Cercospora stephanandrae* Tak. Kobay. & H. Horie (Kobayashi *et al*., 1979), was described on *Stephanandra incisa* Zabel from Japan, which has been transferred to *Pseudocercospora* on the basis of its unthickened and not darkened conidial scars on conidiophores. *Pseudocercospora stephanandrae* (Tak. Kobay. & H. Horie) Nakashima & Tak. Kobay. (2000) is clearly distinguished from the present fungus described here as a new species by having creeping secondary mycelium, short conidiophores (10-23×2.0-3.8 μm), and scolecosporous pigmented conidia (15-60×2.0-3.8 μm).

Phacellium sessile U. Braun on *Sanguisorba canadensis* L. belonging to the family Rosaceae (see Braun, 1998; personal communication, 2000) is similar to the present fungus. But the new fungus has somewhat longer synnemata, conidiophores with up to three branches, and conidia with 0-5 septa in short unbranched or branched chains.

On *Stephanandra* and allied genera, there is no comparable species possessing synnematous conidiophores as in *Phacellium* and the allied genus *Tandonella*. The present species is well-characterized by synnemata pigmented only at the base, colorless conidiogenous cells and conidia, and terminal to pleurogenous conidiogenous cells. These features agree with Braun's (1998) concept of *Phacellium*.

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THE HYPOCREACEAE OF CHINA IV.
SOME NEW RECORDS OF THE GENUS HYPOCREA FOR CHINA[*]

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Abstract: Five species of *Hypocrea*, all new records for China, are reported and descriptions and illustrations of their telemorph and anamorph stages are provided. They are *H. albocornea*, *H. aurantia*, *H. muroiana*, *H. nigricans*, *H. pachybasioides*. Among them three species are endemic to east and south-eastern Asia.

Key words: telemorph, anamorph, taxonomy

Twelve species of the genus *Hypocrea* were recorded and their telemorph state described from China (Teng, 1934, 1963; Tai, 1979). Two other species were added recently (Liu & Doi, 1995; Liu *et al.*, 2000), for a total of 14 species recorded from China. Up to now culture studies of the anamorphs of this genus reported from China are for only four species (Liu & Doi, 1995; Liu *et al.*, 2000). In recent years, some new records of the genus *Hypocrea* from China have been identified among specimens collected in Southwest China. The specimens cited here were deposited in the Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica (HKAS).

The abbreviations in the paper are as follows:

str. = stroma (ta)
p.sp. = partspore (s)
p.p.sp.= proximal partspore (s)
d.p.sp.= distal partspore (s)
t. = *textura*
t.o.s.s. = ostiolate surface tissue of stroma

1. *Hypocrea albocornea* Yoshim. Doi, Bull. Natn. Sci. Mus. **15:** 712, fig. 30, 1972. (Fig. 1)

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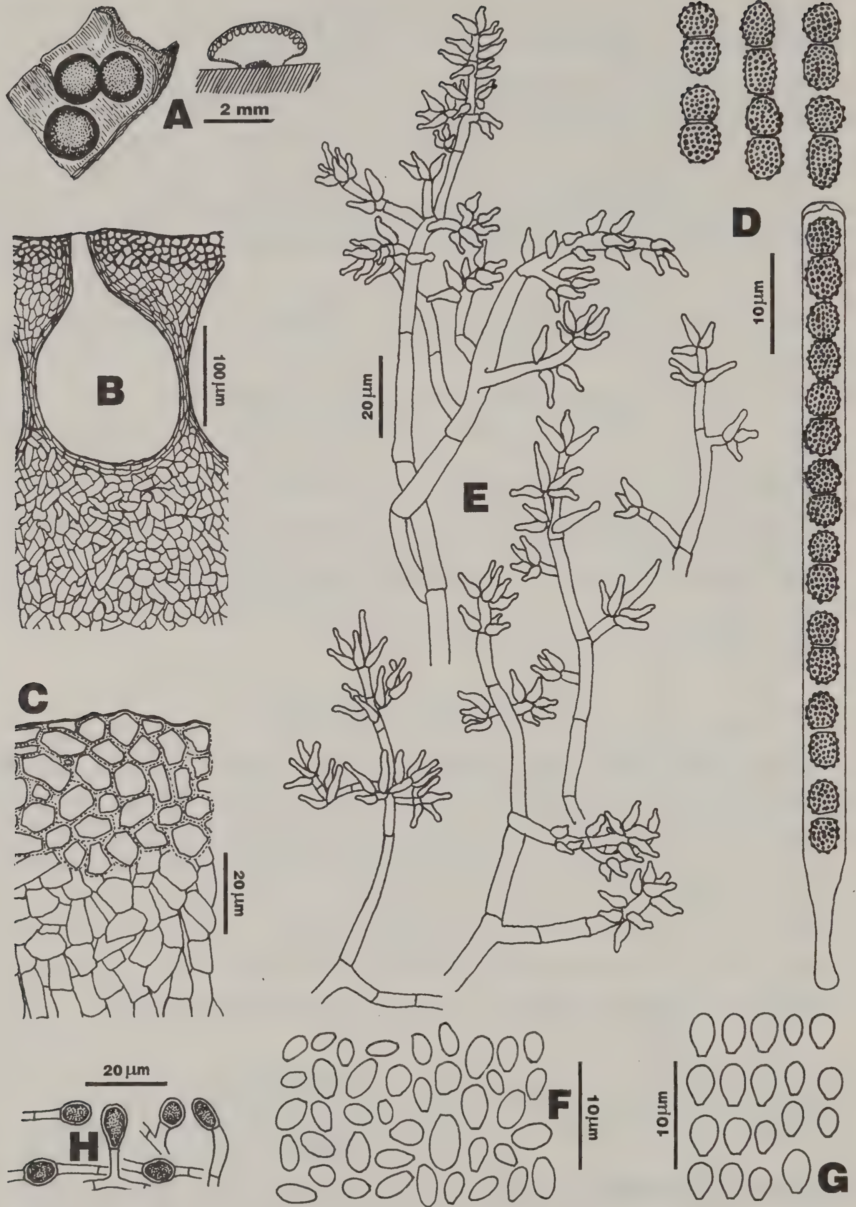
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Fig. 1. *Hypocrea albocornea* Yoshim. Doi (HKAS 26273 = TNS-D-8665). A & B. Habit and vertical section of stroma. C. Vertical section of surface tissue of the stroma. D. Ascus and p. sp. E. Conidiophores and phialides (irregular *Verticillium*-type). F. Conidia in young stage. G. Conidia in aged stage. H. Chlamydospores.

Hab.: On bark or trunk of decaying wood of *Lithocarpus* and *Castanopsis*.

Specimens Examined: Yunnan: Mengla County, Xishuangbanna Tropical Botanical Garden, 570 m, 30. IX. 1993, N. Maekawa, D'93-27 (HKAS 26273 = TNS-D-8665).

Culture Characters: Growth rather rapid. P.sp. germinating over one night; aerial hyphae generally scarce except for conidiophores. Conidiophores of irregular *Verticillium*-type, close to *Trichoderma*-type, forming thin and green colonies as well as covering whole slant media after 5 days culture; the main hyphae of conidiophores up to 500 μm long, 2-5 μm in diam.; phialides ampuliform to flask-shaped, 4.8-13.3 μm long, 1.9- 3.3 μm in diam. Conidia green, smooth, obovate-subcylindrical with a truncate base, usually of various sizes during younger stage, the smallest 2.5 × 1.3 μm, the largest 5.6 × 3.2 μm, and then gradually becoming sustained in size, 3.0-4.5 × 1.5-2.6 μm. Chlamydospores appear in very old culture (six months later), 8.0-10.5 × 5.4-7.5 μm. Reverse side brown in color.

Note: According to most characters, the Chinese specimen is quite close to the original description of the species. Although this species name is accepted here, some differences between the Chinese material and the type (TNS-D-759) follow: 1. The Chinese specimen has smaller p.sp., the d.p.sp. 3.5-3.9 × 3.0-3.5 μm, a few up to 4.6 μm long, the p.p.sp. 3.7-5.5 × 3.1-3.9 μm. 2. All specimens from Japan were unable to grow in malt agar media (Doi, 1972). Except these, there are almost no differences between them.

The specimen is also similar to *H. cornea* Pat. in many ways, but they are different in 1. The str. of the Chinese specimen are dispersed, sometimes 2 or 3 str. confluent and forming irregular masses. Str. disciform to hemispherical pulvinate with a narrow base, 1.2-2.5 mm in diam., 1-2 mm thick; creamy to yellowish with white margin in young stage, black-green with p.sp. on the surface in well-matured stage, becoming black in dried specimens. 2. The cell of the inner tissue thin-walled and hyaline. 3. All asci containing 16 p.sp., and the p.sp. smaller. 4. The anamorphic stage grows rapidly, reverse side not dark purple.

Known Distribution: Japan, new to China.

2. *Hypocrea aurantia* Henn., Monsunia I, 173, 1899; Sacc. Syll. Fung. **16:** 584, 1902. (Fig. 2)

Str. scattered, hemispherical or irregularly pulvinate, ochre to carneous in fresh material, brown to dark brown and rugose on the surface of str. in dried specimens, slightly narrower where attached to the substratum, usually 1.0-2.5 mm in diam., 0.4-0.9 mm thick. T.o.s.s. of *t. epidermoidea*, more or less resembling *t. angularis*, cells of t.o.s.s. slightly thick-walled, pale ochre,

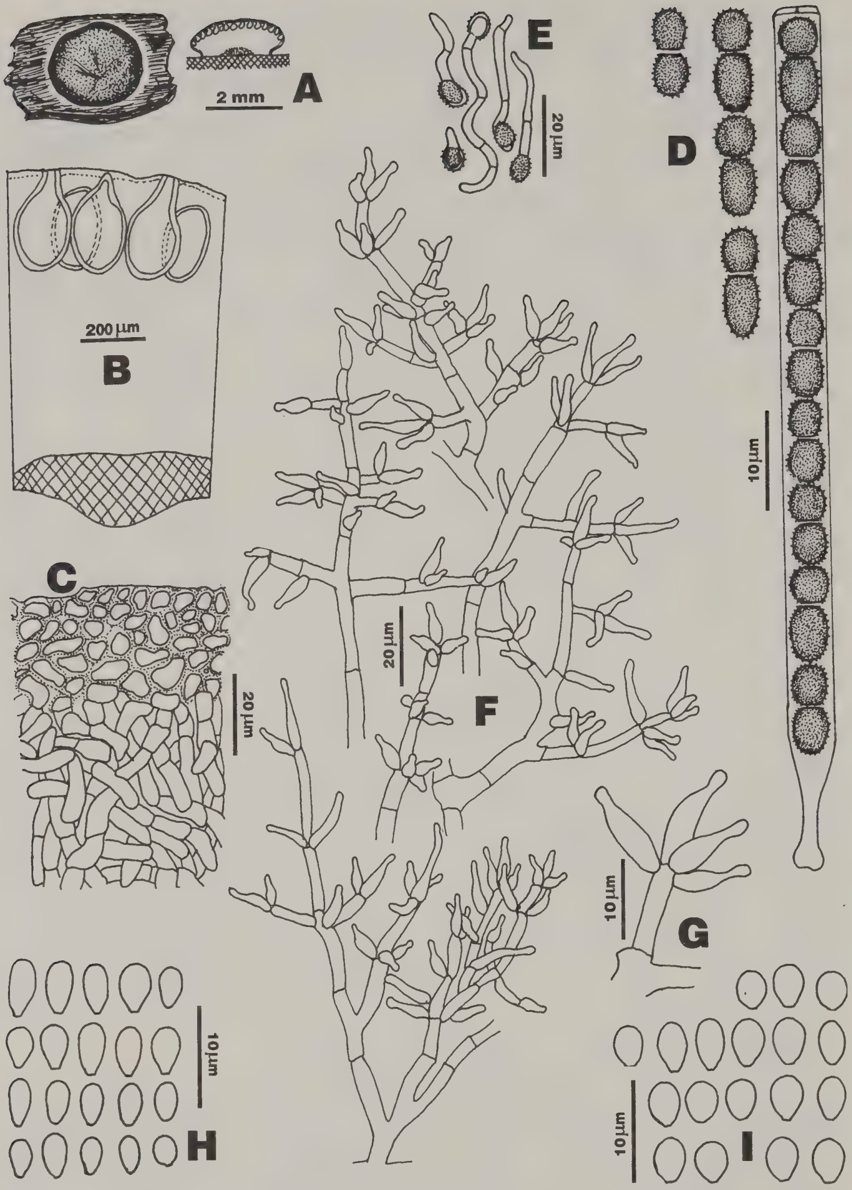
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Fig. 2. *Hypocrea aurantia* Henn. (HKAS 26263=TNS-D-8688). A & B. Habit and vertical section of stroma. C. Vertical section of surface tissue of the stroma. D. Ascus and p.sp. E. Germinating p.sp. F & G. Conidiophores and phialides (*Trichoderma*-type). H. Conidia in young stage. I. Conidia in aged stage.

3.8-7.6 µm in diam. Inner tissue of *t. intricata*, cells vertically elongate, cylindrical, 2.5-7.5 µm in diam. Perithecia subglobose or elliptical, 180-250 µm in vertical diam., 120-160 µm in transverse diam.; necks of ostioles cylindrical, 60-85 µm long, 25-40 µm in diam. P.sp. hyaline, densely echinulate; d.p.sp. globose to subglobose, 3.9-4.8 × 3.5-4.0 µm, mean length (of 60 p.sp.) 4.35 µm, mean breadth 3.75 µm, mean L/B ratio 1.16; p.p.sp. obovate-subcylindrical to subcylindrical, 4.2-6.5 × 3.3-3.9 µm, mean length 5.17 µm, mean breadth 3.56, mean L/B ratio 1.45.

Hab.: On rotten wood of *Lithocarpus* and *Castanopsis* in tropical forest.

Specimens Examined: Yunnan: Mengla County, Cuipingfeng Tropical Rainy Forest Park, 700 m, 1. X. 1993, P. G. Liu, D'93-48 (HKAS 26263 = TNS-D-8688); Menghai County, Nannuoshan, 560 m, 8. VIII. 1994, Y. Doi, D'94-80 (HKAS 28761 = TNS-D-8818).

Culture characters: Growth very rapid; P.sp. germinating over one night, the hyphae at first composed of closely septate, and then elongating into cylindrical cells; aerial hyphae and conidiophores of *Trichoderma*-type, produced and dispersed over culture media after three days. The main hyphae of conidiophores up to 350 µm long, 2-6 µm in diam.; phialides slender flask-shaped, 10-18 × 2.3-3.5 µm, usually changing into subampuliform, 5.7-13.3 × 3.3-4.3 µm at maturity. Conidia green, smooth, subglobose to obovate-ellipsoid with truncate base, 2.5-4.2 × 1.9-3.3 µm. Chlamydospores not observed even in old cultures. Reverse side brownish.

Note: According to the diagnostic descriptions of the species (Saccardo, 1902), the specimens cited above are almost equal to the diagnosis except for its large str. (up to 5-12 mm in diam.) and globose p.sp. (4 µm in diam.). The anamorphic state and its characters are first described and illustrated here.

Known Distribution: Java (Indonesia), new to China.

3. *Hypocrea muroiana* I. Hino et Katum., Bull. Fac. Agr. Yamaguchi Univ. **9:** 888, 1958. (Fig. 3)

Hab.: On decaying wood or bamboo.

Specimens Examined: Yunnan: Mengla County, Xishuangbanna Tropical Botanical Garden, 570 m, 2. X. 1993, Y. Doi, D'93-32 (HKAS 26192 = TNS-D-8673); Mengla County, Cuipingfeng Tropical Rainy Forest Park, 750 m, 1. X. 1993, P. G. Liu, D'93-36 (HKAS 26277 = TNS-D-8676); The same locality, 17. VIII. 1994, P. G. Liu, D'94-23 (HKAS 28735 = TNS-D-8919); Menghai County, Nannuoshan, 1500 m, 3. X. 1993, Y. Doi, D'93-41 (HKAS 26253 = TNS-D-8681); Menghai County, Daluo, 1300 m, 9. VIII. 1994, Y. Doi, D'94-89 (HKAS 28765 = TNS-D-8825); Menghai County, Chashuwang, 10. VII. 1994, Y. Doi, D'94-97 (HKAS 28759 = TNS-D-8831) (immature); Jingdong County, Ailaoshan, 2600 m, 26. VIII. 1994, S. Uchiyama, D'94-7 (HKAS 28757 = TNS-D-8897); Deqin County, Meilixueshan, 3400 m, 28. IX. 1994, P. G. Liu, D'94-87 (HKAS 28688 = TNS-D-8949); **Guizhou:** Jiangkou County, Fanjingshan Nature Reserve, 450 m, 22. IX. 1995, P. G. Liu, Liu'95-26 (HKAS 29679

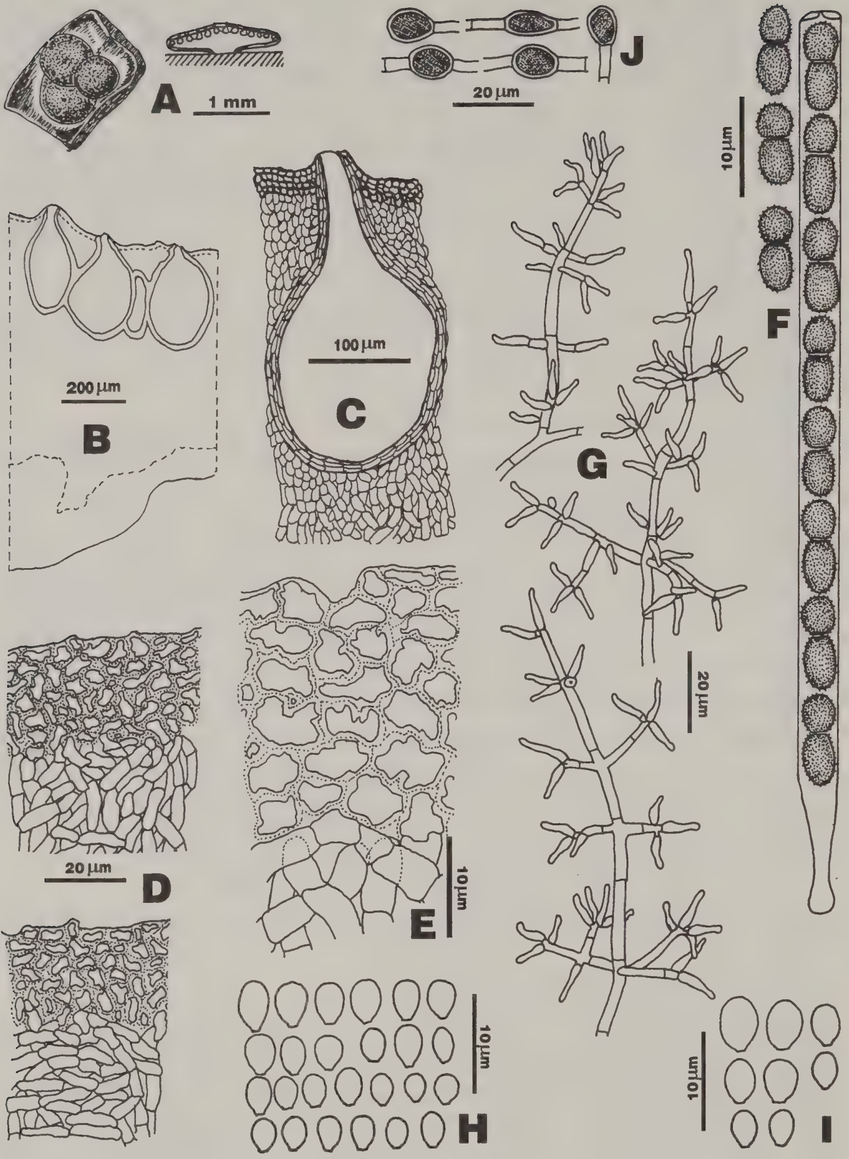
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Fig. 3. *Hypocrea muroiana* I. Hino et Katum. (HKAS 26277=TNS-D-8676). A & B. Habit and vertical section of stroma. C. Vertical section of perithecium. D & E. Vertical section of t.o.s.s F. Ascus and p. sp. G. Conidiophores and phialides (*Trichoderma*-type). H. Conidia (HKAS 26277) I. Conidia (HKAS 26192) J. Chlamydospores.

= TNS-D-9180); The same locality, 400 m, 21. IX. 1995, P. G. Liu, Liu'95-15 (HKAS 29677 = TNS-D-9155); The same locality, 1850 m, 21. IX. 1995, P. G. Liu, Liu'95-19 (HKAS 29669 = TNS-D-9173).

Culture Characters: Growth rapid; aerial hyphae white, densely covering whole agar slant culture over one day and then turning into pale green colonies and forming compact masses when aged. The conidiophores erect, of *Trichoderma*-type, close to *Verticillium*-type. Main hyphae of conidiophores up to 270 µm long, 2.3-3.5 µm in diam.; phialides slender at first, some becoming bottle-shaped in aged stage, 6.2-17.0 µm long, 1.8-3.0 µm in diam. Conidia green, smooth, obovate-ellipsoid, most obovate subglobose with a truncate base in each conidium, 2.5-5.4 × 2.3-3.9 µm. Chlamydospores 9.5-12.4 × 6.7-8.6 µm, ellipsoid to subglobose, most terminal, some intercalary, thick-walled, brownish, abundant in old culture. Reverse side of colonies brown with reddish tint in young stage, dark brown in old culture.

Note: Two new forms of this species, *H. muroiana* f. *minor* and *H. muroiana* f. *dimorphospora* were published by Doi (1975). Neither form was found in our collections. Our collections (d.p.sp.: 3.4-4.6 × 3.2-4.0 µm, p.p.sp.: 4.0-5.8 × 2.7-3.5 µm) are similar to *H. muroiana* f. *muroiana* (d.p.sp.: 3.2-4.4 × 3.0-4.1 µm, p.p.sp.: 3.8-5.0 × 2.7-3.2 µm).

Known Distribution: Europe, Latin America (Colombia), Japan, new to China.

4. ***Hypocrea nigricans*** (S. Imai) Yoshim. Doi, Bull. Natn. Sci. Mus. **15(4)**: 732, 1972. (Fig. 4)

Basionym: *Chromocrea nigricans* S. Imai, Trans. Sapporo. Nat. His. Soc. **14**: 102, 1935.

Hab.: On decaying wood in broad-leaf or needle and broad-leaf mixed forest.

Specimens Examined: Yunnan: Mengla County, Xishuangbanna Tropical Botanical Garden, 570 m, 30. IX. 1993, P-G Liu, D'93-39 (HKAS 26280 = TNS-D-8679); The same locality, 570 m, 30. IX. 1993, Y. Doi, D'93-43 (HKAS 26206 = TNS-D-8683); Kunming, Xishan, 1950 m, 11. IX. 1993, N. Maekawa, D'93-9 (HKAS 26257); Zhongdian County, Dabaosi, 3450 m. 20. IX. 1993, Y. Doi, D'93-57 (HKAS 26252 = TNS-D-8697); **Guizhou:** Jiangkou County, Fanjingshan Nature Reserve, 800 m, 20. IX. 1995, P. G. Liu, Liu'95-14 (HKAS 29673 = TNS-D-9168).

Culture Characters: Growth rapid; aerial hyphae almost filling the slant tubes and producing pale green, dispersed colonies over four days at 24-26℃. Conidiophores produced and dispersed among the aerial hyphae, and forming compact, whitish colonies on the upper parts of the culture media in young stage, and then becoming green colonies due to the green dispersed conidia, of the *Trichoderma*-type, similar to *T. harzianum* (Samuels

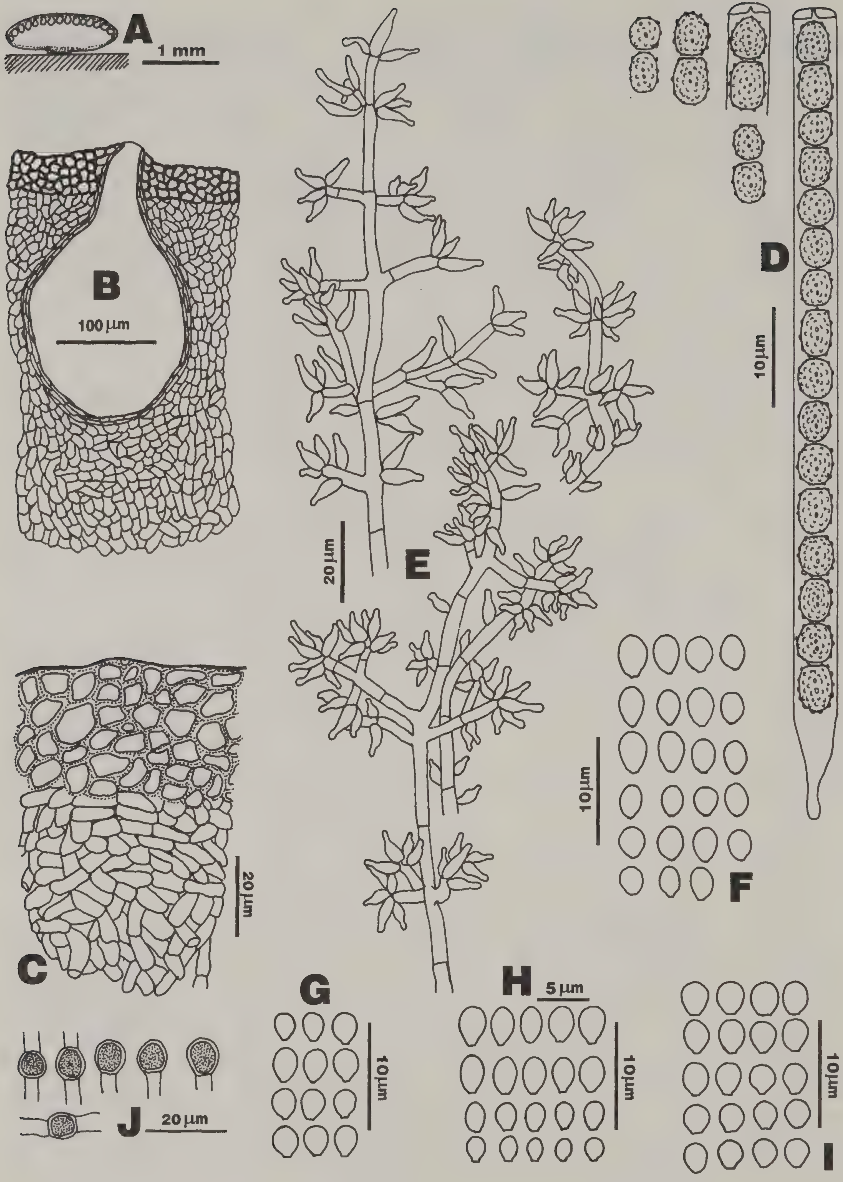
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Fig.4. *Hypocrea nigricans* (S. Imai) Yoshim. Doi (HKAS 26289=TNS-D-8679). A. Vertical section of stroma. B. Vertical section of perithecium. C. Vertical section of surface tissue of the stroma. D. Ascus and p. sp. E. Conidiophores and phialides (*Trichoderma*-type). F. Conidia (HKAS 26252) G. Conidia (HKAS 26206) H. Conidia (HKAS 26289). I. Conidia (HKAS 26280). J. Chlamydospores.

et al., 1990). Main hyphae of conidiophores up to 420 μm long, 3.3-4.0 μm in diam. Phialides slender, most flask-shaped, 5.7-17.0 × 2.9-3.8 μm. Conidia green, smooth, obovate-ellipsoid, with a truncate base for each conidium, 1.9-4.2 × 1.5-3.1μm. Chlamydospores abundant in the old culture, subglobose or globose, slightly roughened walls, 6.7-9.5 × 6.7-7.6 μm. Reverse side not colored.

Note: The Chinese collections and cultures are almost identical with the holotype from Japan (TNS-F-223344), except the p.sp. are a little smaller (d.p.sp.: 3.7-4.5 × 3.0-3.9 μm, p.p.sp.: 4.2-4.8 × 2.9-3.7 μm) compared with Japanese specimens (d.p.sp.: 3.6-4.8 × 3.2-4.3 μm, p.p.sp.: 4.1-6.6 × 3.1-3.8 μm (Samuels *et al.*, 1990).

Known Distribution: Japan, Indonesia, new to China.

5. ***Hypocrea pachybasioides*** Yoshim. Doi, Bull. Natn. Sci. Mus. **15(4)**: 685, 1972. (Fig. 5)

Hab.: On decaying branches of broad-leaf tree (*Quercus* sp.).

Specimens Examined: Yunnan: Lijiang County, Daju, Sandaowan, 3200 m, 15. IX. 1993, N. Maekawa, D'93-60 (HKAS 26271 = TNS-D-8700); Pingbian County, Daweishan Nature Reserve, 2000 m, 6. IX. 1995, P. G. Liu & Y. Doi, D'95-60 (HKAS 29655 = TNS-D-9204); The same locality, 2000 m, 6. IX. 1995, P. G. Liu & Y. Doi, Doi'95-58 (HKAS 29696 = TNS-D-9203); Malipo County, Laojunshan, 3. X. 1995, 1450 m, P. G. Liu & Y. Doi, D'95-47 (HKAS 29697 = TNS-D-9195); **Guizhou:** Jiangkou County, Fanjingshan Nature Reserve, 1850 m, 21. IX. 1995, P. G. Liu & Y. Doi, D'95-23 (HKAS 29666 = TNS-D-9177).

Note: Our collections are very similar to the original descriptions of this species (Doi, 1972) except for the following differences: 1. d.p.sp. obovate-subglobose, 3.7-6.5 × 3.3-4.3 μm, mean length (of 60 p.sp.) 5.14 μm, mean breadth 3.85 μm, mean L/B ratio 1.34; p.p.sp. obovate-subcylindrical, 4.6-7.3 × 3.5-3.7 μm, mean length 5.85 μm, mean breadth 3.61 μm, mean L/B ratio 1.62. 2. The Japanese conidia generally smooth, but sometimes roughened especially in the young stage, and smaller (Doi, 1972). The Chinese conidia hyaline, smooth, ellipsoid with a truncate base and little bigger 2.0-4.8 × 1.5-2.9 μm. Chlamydospores abundant in old culture, ellipsoid to subglobose, 9.0-14.2 × 5.7-8.3 μm. Reverse side of colonies brown in old culture media. The species is characterized by pale yellow-ochre to pale carnose-brown, pulvinate str. and the *Pachybasium*-type conidiophores with hyaline, minute, and ellipsoid conidia. The specimens cited here are of these basic characters, therefore the specimens cited above are identified as the species.

This species is very common, especially on logs used in cultivating *Lentinula edodes* in Japan, and is also very common in southern China. It grows mainly late in autumn or early spring at low altitudes in the plains or in

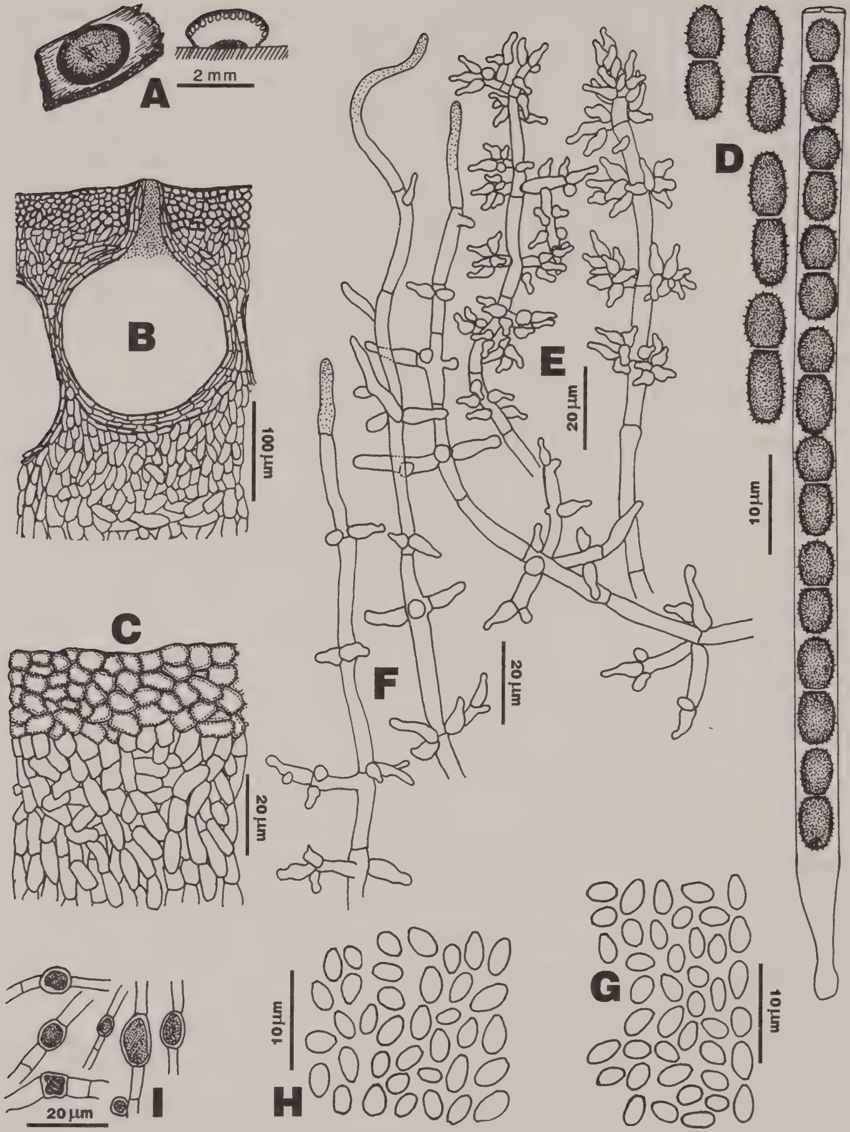
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Fig.5. *Hypocrea pachybasioides* Yoshim. Doi (HKAS 26271=TNS-D-8700). A. Habit and vertical section of stroma. B. Vertical section of perithecium. C. Vertical section of surface tissue of the stroma. D. Ascus and p.sp. E & F. Conidiophores with sterile apices and phialides (*Pachybasium*-type). G. Conidia in young stage. H. Conidia in aged stage. I. Chlamydospores.

summer on higher mountains.

Known Distribution: Czechoslovakia (Bohemia), Japan, Southern Korea, new to China.

ACKNOWLEDGEMENTS

Sincere appreciation is due to Prof. R. P. Korf, Plant Pathology Herbarium, Cornell University, New York, U.S.A. for his helpful suggestions and critical review of this manuscript. The first author is very grateful to Dr. Y. Doi, National Science Museum, Tokyo, Japan for kindly inviting and allowing him access to the specimens deposited in TNS and for providing him helpful guidance, as well as copies of his publications.

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Doi, Y. (1975): Revision of Hypocreales with culture observations. VII. The genus *Hypocrea* and its allied genera in South America (1). *Bull. Natn. Sci. Mus. Ser. B.* (Tokyo) **1:** 1-33.

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中国肉座菌科 IV.

肉座菌属的中国新记录种

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中文摘要：报道了肉座菌属（*Hypocrea*）的 5 个中国新记录种，并对它们的有性阶段和无性阶段进行了详细的描述和宏、微观图示。它们是白角肉座菌（*H.*

albocornea)、橙色肉座菌（*H. aurantia*）、木肉座菌（*H. muroiana*）、黑肉座菌（*H. nigricans*）、硬拟底肉座菌（*H. pachybasioides*）。其中白角肉座菌、橙色肉座菌、黑肉座菌为东亚和东南亚特有种。

关键词：有性型，无性型，分类

MYCOTAXON

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BOOK REVIEWS AND NOTICES

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GENERAL

Ainsworth & Bisby's Dictionary of the Fungi. By Paul M. Kirk, Paul F. Cannon, John C. David & Joost A. Stalpers. 9th edn. 2001. CAB International, Wallingford, Oxon OX10 8DE. Pp. xi + 655. ISBN 0 85199 377 X. Price: £ 49.95, US $ 90.

From my earliest days as a mycologist way back in the 1940s, Ainsworth & Bisby's *Dictionary* has been a revered 'bible' for me and most other mycologists. This ninth edition continues a tradition of excellence and scholarly exactitude. It is, moreoever, remarkably up-to-date for our ever-changing science. We owe the compilers a resounding round of applause for a job not just well done, but superbly done. The technical aspects of printing and binding appear also to be first-rate, a necessity for any volume constantly opened and used.

As new features are a synopsis of their proposed classification, a major revision of the classification of the *Ascomycota*, as well as of the *Basidiomycota*, an integration of anamorphic genera in the classification, and a refined classification of the fungal phyla based on molecular evidence. The keys that appeared in the last edition have been omitted, but, as these are revised to reflect the new classification, the editors plan to place these keys on the CABI Bioscience databases website at www.indexfungorum.org. As in the eighth edition, useful references accompany many entries.

None of us can afford not to have a copy of this book at arm's length. Students deserve a copy in their laboratories. In summary: order it now.

RICHARD P. KORF
Plant Pathology Herbarium, Cornell University, Ithaca, NY 14853, USA.

Wörterbuch der Mykologie. Edited by Heinrich Dörfelt & Gottfried Jetschke. 2nd edn. 2001. Spektrum Akademischer Verlag GmbH, Heidelberg, Germany. [Distributed by Sigloch Distribution GmbH, Am Buchberg 8, 74572 Blaufelden, Germany.] Pp. 367, 16 col. pl. ISBN 3 8274 0920 9. Price: DM 59.90.

This is a second edition of the *Bi-Lexicon Mykologie-Plizkunde* edited by Heinrich Dörfelt and issued in 1988 (Dörfelt 1988). It is not to be confused with the *Mykologische Wörterbuch* edited by Karl Berger (Berger 1980) which gives the equivalents of terms in eight languages. The similarity in the titles is regrettable.

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[1] Books for consideration for coverage in this column should be mailed to the Book Review Editor at MycoNova (address above) in the first instance. Fax (+34) 91 857 3649; e-mail: davidh@farm.ucm.es or myconova@terra.es.

In preparing the new edition, the editors have again been fortunate in securing the assistance of 14 other mycologists (cfr 8 in the last edition), mostly well-known specialists in their fields to help ensure its authoritativeness. There are over 3000 entries covering, terms, chemicals, individuals, taxa, and miscellaneous items (e.g. kinds of fermented drinks). There are numerous line drawings within the body of the text and also 40 colour photographs on 16 plates (there were 48 plates in the first edition). The insides of the covers continue the tradition of having diagrams illustrating the position of fungi amongst all living organisms and the development of different kinds of basidiomes.

The definitions are in general full and precise, and the numerous cross references (words prefixed by an →) a particularly helpful feature. The names of the authors of each entry are indicated by initials, but sadly literature references are not included in individual entries so it is not always clear who is being followed. Just over five pages are devoted to literature under broad topics, but only books, not journal articles, are included in the list.

Systematic entries include higher taxa down to and including order, and then selected genera – with an emphasis on macromycetes and economically important genera. The systematic arrangement contains some surprises, for example the separation of the *Chytridiomycota* from the *Eumycota,* and a variety of class and other higher taxon names I had not encountered before, such as *Palaeomycetes, Gasteromycetanae, Lecanoromycetidae* (syn. *Archaeascomycetidae*), and *Pyrenomcetanae* – and many perhaps not yet validly published under the *Code.* Ascomycetologists should note that the term *Archaeascomycetidae* in the sense of *Lecanorales* s. lat. (with archaeasci) already appeared in the 1988 edition; the *Archiascomycetes*, of Nishida & Sugiyama (1994) have quite a different circumscription . . . . While to propose different classifications for debate and testing against new data is a part of the progress of science, in a general text it would have been useful also to have a more detailed comparison of the system used with those adopted in other contemporary works than the small table on p. 315.

While this book does not aim to be comprehensive in the same way as *Ainsworth & Bisby's Dictionary of the Fungi* (see above), it will have a wide appeal amongst German-speaking mycologists and those with more limited budgets. At the same time it can also be complementary as terms can be found here which appear not to be in even the latest edition of that *Dictionary* (e.g. aulathecium and lysothecium on p. 126), and it has many more line drawings and also structural formulae of selected fungal products. The *Wörterbuch* will also serve as an aid to non-German-speaking mycologists working with German texts and so merits a place on the shelves of all major mycological libraries.

Berger, K. (ed.) (1980) *Mykologische Wörterbuch*. Gustav Fischer Verlag, Stuttgart.
Dörfelt, H. (1988) *Bi-Lexicon Mykologie-Plizkunde.* VEB Bibliographisches Institut, Leipzig.
Nishida, H. & Sugiyama, J. (1994) *Archiascomycetes:* detection of a major new lineage within the *Ascomycota. Mycoscience* **35**: 361-366.

Tropical Mycology. Vol. 1. Macromycetes. Edited by Roy Watling, Juliet C. Frankland, A. Martyn Ainsworth, Susan Isaac & Claire H. Robinson. 2002. CABI Publishing, Wallingford. Pp. xiii + 191. ISBN 0 85199 542 X. Price: £ 40, US $ 75. .

This volume, dedicated to the late John Corner (1906-1996), comprises 12 contributions focusing on macromycetes from the British Mycological Society's Millenium Symposium held at Liverpool John Moores University in April 2000. A second volume with papers stressing micromycetes is promised shortly. The topics are wide ranging but tend not to be global overviews but have strict regional foci. Most concern the diversity of larger fungi or particular groups of fungi in the neotropics, Africa, Malaysia, the Greater Antilles, Mexico, Indonesia, Taiwan, Ecuador, India, China, and Tanzania. None are strictly systematic, but many provide insights into the state (or rather lack of) of our knowledge of macromycetes in the tropics. For example, of 95 species recorded over 2.5 years in the Pasoh Forest Reserve in Malaysia, only 52 could be named to species. Although not a book for the strict systematist, it provides insights into the problems of studying macrofungi in tropical situations and is fascinating to even skim through and reflect on the progress made in our understanding and the huge gulfs to be explored. There is also material to interest the ethnomycologist, ecologist, bioprospector, and mushroom cultivator. Quite a few of the chapters have extensive reference lists bringing together scattered work on the areas under consideration and have an especial value on that count.

The book is generally well-edited and produced, but perhaps suffered a little by the load being shared too much as there are editorial inconsistencies between chapters, such as the inclusion of author citations of species in some but not others. As the book is of only a modest size, if the micromycete companion volume is to be of a similar thickness I wonder why two volumes were necessary at all. If both are priced similarly, I wonder how many mycologists in the tropics would be able to pay US $ 150 for the set ? The pricing issue is something the Society and publisher need to address if they really want to make such studies available where they are needed most.

Atlas of the Geographical Distribution of Fungi in Poland. Fascicle 1. Edited by Władyslaw Wojewoda. 2000. Władyslaw Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31-512 Kraków, Poland. Pp. 61. ISBN 83 85444 76 9. Price: US $ 17.

The launch of a new series with the aim of documenting the distribution of all groups of non-lichenized fungi in Poland is commendable (lichenized taxa have a separate series which started publication in 1971, Tobolweski 1971, and another that commenced in 1993, Cieśliński & Faltynowicz, 1993). This first fascicle covers ten species, mostly macromycetes; the genera represented are *Asterodon, Bondarzewia, Cyphellostereum, Eocronartium, Ganoderma, Inonotus, Peniophora, Porostereum, Stypella* and *Xylobius*. For each the nomenclature and systematic positions are summarized, followed by descriptions, notes on similar species, ecology, and world distribution (all in English). The maps have altitudinal zones shaded which is helpful, and localities stand out clearly as red spots. Full details are given of each locality, and entries conclude with a detailed list of references. It will be interesting to see this series build over time into an extraordinarily detailed coverage of the country's mycobiota, but I do hope that in future more care is taken with the nomenclature. Sanctioned name citations and references are given where they apply. However, in all but one case, the actual reference to the place of publication of the basionym is not given, the reference to the place of sannctioning being stated to be the basionym; I never expected the changes made in the *Code* back in 1981 would prove so difficult to interpret correctly.

Cieśliński, S. & Fałtynowicz, W. (1993) *Atlas of the Geographical Distribution of Lichens in Poland.* Part 1. Władysław Szafer Institute of Botany, Kraków,

Tobolewski,, Z. (1971) *Atlas Rozmieszczenia Roslin Zarodnikowych w Polsce.* Seria III. *Porosty (Lichenes).* Zeszyt 1. Komitet Botaniczny Polskiej Akademii Nauk, Poznań.

Reperti rari e nuovi della zona montana e subalpina della Valsesia. By Pier Giovanni Jamoni. 30 July 2001. Libreria Mykoflora, di Maria Teresa Basso, Via Ottone Primo 90, I-17021 Alassio-Moglio (SV), Italy. [Fungi non Delineati raro vel haud perspecte et explorate descripti aut definite picti No. 14.] Pp. 60. SIN 1128-6008. Price: □ 8.26.

This report, based on 25 years study in the region, includes descriptions of two new discomycetes, *Otidea mirabilis* and *Peziza danielii,* and *Alnicola bohemica* f. *gracilis* f. nov. Also treated are *A. luteofibrillosa, Entoloma allochroum, Galerina pseudocamerina, Gymnopillus bellulus, Omphaliaster nauseodulcis, Peziza flavovirens, P. lividula, Pholiota tuberculosa, Psilocybe velifera, Psilopezia nummularia, Simocybe centunculus* var. *filopes,* and

S. reducta. The species, mostly first records for Italy, are described in detail and illustrated by line drawings and colour habit photographs.

STRAMINOPILOUS FUNGI

Straminipilous Fungi: Systematics of the *Peronsporomycetes* including accounts of the marine straminipilous protists, the plasmodiophorids and similar organisms. By Michael W. Dick. July 2002. Kluwer Academic Publishers, P. O. Box 989, 3300 AZ Dordrecht, The Netherlands. Pp. xv + 670. ISBN 0 7923 6780 4. Price: □ 295, US $ 290, £ 195.

This long-awaited monograph[1] must surely rank as one of the largest systematic works by a single author published in mycology for several decades. The number of pages alone may not seem so striking, but this is an A4 format work with substantial sections of the book printed in 8/9 pt type. It represents the distillation and synthesis of a life-time's work on groups of organisms which the author has long been recognized as being the foremost world authority. Even if some have found his views controversial, they have always provided grounds for healthy scientific debate.

The term 'straminipilous', sometimes spelled as 'straminopilous', has been in informal use for fungus-like organisms with two kinds of flagellae, one unelaborated, but the other with brush-like lateral outgrowths. The kingdom name *Straminipila* is validly published for the first time here, and used in preference to Cavalier-Smith's kingdom name *Chromista* which dates from 1981 and has been used widely by mycologists for oomycete fungi (or 'pseudofungi') and their allies. Michael Dick took this step because he believes that the occurrence of photosynthetic plastids (from an endosymbiont) in these organisms is an evolutionarily later development and that ancestral forms were heterotrophic. The *Straminipila* as defined here includes the oomycete or peronsoporomycete fungi together with certain algal groups (including diatoms and phaeophytes) and monads.

The kingdom includes a single phylum, *Heterokonta,* with three subphyla: *Bicoecia, Labyrinthista,* and *Peronosporomycotina* (syn. *Pseudofungi*). The work will perhaps also be the death-knell not only for the term *Pseudofungi,* but further for the even more familiar *Oomycota* and *Oomycetes* -- something that was pleaded for by F. K. Sparrow back in 1976 but which has persisted in numerous text-books and reference works.

The book is divided into a number of parts. The first provides a critical analysis of characters used in the diagnosis of flagellate fungi, with information on the ultrastructure of the flagellae and their mode of operation, zoosporogenesis and cyst formation, sexual reproduction, cytology, cell-wall structure, and molecular biology. Part II provides an overview of the classifications, including historical treatments and discussions of evolutionary origins. Part III provides a survey of the myceliar peronosporomycetes (i.e. downy mildews and water moulds) which includes a stimulating discussion of coevolution with plants – although much is necessarily speculative, the hypotheses put forward are now available for further testing. Part IV addresses the laginidaceous fungi and similar organisms, with lists of previously used names and fascinating insights into the ecology of these fungi that are sure to intrigue – including nematophagous species and ones parasitic on *Pythium,* algae, other protists, etc.

The systematic core starts with Part V with citations of taxa at all ranks from kingdom down to species, including numerous new ordinal, family, and generic names, and inevitably many new combinations. Full synonymies are presented at all levels, and particular care has been taken to typify names wherever possible, no small feat in groups which are rarely adequately preserved and where it has been necessary in many cases to designate illustrations as lectotypes. Descriptions other than for new taxa are not included in this Part, but Part VI consists of a series of keys down to species level which include rather full information on their characters. These keys will make the identification of organisms in many of the groups practical for the first time as it is only the plant pathogenic species that have historically been regularly monographed. My one wish in this section would have been to see a selection of photographs which I am sure would greatly facilitate users and add to its appeal – not least because the author is well-known for his high-quality photographs and electron micrographs.

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[1] This work was originally planned and advertised in the late 1990s as *Mycological Paper* **168**, but eventually outgrew what could be accommodated in that series.

The Appendices include lists of binomials in current use, author abbreviations employed (with notes on biographical information), a glossary, and an exceptional 75 page small-print bibliography which includes all citations of most treated genera to date. The book concludes with indices to genera and binomials.

In view of its broad scope, and treatment of numerous plant pathogens, including well-known genera such as *Peronospora*, *Phytopthora*, and *Pythium*, this is destined to be a mycological, if in part controversial, classic. All major mycological and plant pathological libraries should endeavour to secure a copy while stocks last.

ASCOMYCETES

A Monograph of *Bionectria* (*Ascomycota, Hypocreales, Bionectriaceae*) and its *Clonostachys* anamorphs. By Hans-Josef Schroers. November 2001. Centraalbureau voor Schimmelcultures, P. O. Box 85167, 3508 AD Utrecht, The Netherlands. Pp. 214, figs 99. [Studies in Mycology No. 46.] ISBN 90 70351 44 7. Price:□ 50.

Following the reappraisal of family and generic concepts in hypocrealean fungi by Rossman *et al.* (1999), monographs of the larger genera have been very much needed. This one on *Bionectria*, the former *Nectria ochroleuca* group, has been worth waiting for. What an excellent revision, combining extensive molecular information with cultural studies, detailed descriptions of teleomorphs and anamorphs, superb half-tones and line drawings, and full details of the collections and isolates studied ! It deserves to be used as a model of how modern revisions of pleomorphic fungi should be carried out and presented.

Forty-four species are accepted, of which 20 are described as new and nine are only known as anamorphs. The species are grouped into six subgenera, all newly described: *Astromata, Bionectria, Epiphloea, Myronectria, Uniparietina* and *Zebrinella*. The subgenera are based primarily on the anatomy of the stromata and perithecia and also ascospore ornamentation and septation. The ascospore ornamentation can be verruculose or striate in some subgenera, and it would have been good to see scanning electron micrographs of ascospores included. There is a comprehensive suite of six keys: to genera of *Bionectriaceae* and similar fungi with superficial free perithecia; hypocrealean genera with penicillate conidiophores; *Bionectria/Clonostachys* species based on ascomatal characters; *Bionectria/Clonostachys* species based on the anamorphs; members of the *Bionectriaceae* with greenish conidial masses based on ascomatal features; and anamorphs with greenish conidial masses.

That *Clonostachys* would be taken up for the anamorphs was inevitable, but six genera are treated as synonyms: *Clonostachyopsis, Dendrodochium, Gliocladochium, Spicaria, Sesquicillium,* and *Verticilliodochium.* Several familiar species formerly placed in *Gliocladium* are also included in *Clonostachys*, although *Gliocladium s. str.* is acceptable for anamorphs of the fungicolous *Sphaerostilbella* and *Hypocrea* sect. *Pallidae* species. *C. rosea* (syn. *Gliocladium roseum*) is confirmed as the anamorph of *B. ochroleuca*, while *C. compactiuscula* is the anamorph of the newly described *B. compactiuscula*. In both these species, the anamorphs are much more widespread than the teleomorphs. *Gliocladium catenulatum* is treated only as a form of *C. rosea* despite the distinctive green rather than pink conidial masses.

Binomial names, many newly described or recombined, are introduced for anamorphs whose teleomorphs are known in spite of the advice given in the *Code* (Art. 59A.3). I was sad to see this and was not convinced by the arguments put forward to justify this flagrant breach of the *Code's* recommendation. In general the nomenclatural and bibliographical aspects are well-researched, and impeccably presented, as might be expected in a work supervised by Walter Gams, although I was surprised to see 'Schmidt in Link' as part of an author citation in seven instances on p. 203. There is an index to scientific names, but not one to hosts which would have been helpful; I also wondered what the 'lichens on bark' that support *B. impariphialis* were. While I appreciate that it would have involved more work, it would have been good to see all names proposed in the synonymized anamorph genera treated – even if only in a section on 'Excluded species'.

Notwithstanding these minor points, this a landmark publication which is surely destined to remain the basic work on these common and widespread fungi for many decades. All working with *Gliocladium*-like fungi will need to have a copy.

Rossman, A. Y., Samuels, G. J., Rogerson, C. T. & Lowen, R. (1999) Genera of *Bionectriaceae, Hypocreaceae* and *Nectriaceae* (*Hypocreales, Ascomycetes*). *Studies in Mycology* **42**: 1-248.

A World Monograph of *Anthostomella.* By Binsheng Lu & Kevin D. Hyde. 2000. Fungal Diversity Press, Department of Ecology and Biodiversity, University of Hong Kong, Pokfulham Road, Hong Kong. Pp. xi + 376. ISBN 962 85677 7 2. Price: Not indicated.

While it is good to see all the information on a single genus brought together, I have the impression that this work was compiled somewhat more hastily than the title implies. The abstract claims that the genus is 'presently comprising over 300 species', a marked contrast to the 50 noted in the ninth edition of *Ainsworth & Bisby's Dictionary of the Fungi* (2001). However, 86 species are accepted here, 95 synonymized, 105 excluded, and 65 treated as doubtful. The study is based on an examination of some 2 600 specimens, but is marred by the fact that 13 herbaria from which material was requested failed to provide the required collections.

Especially valuable is the key to 17 'similar' genera, and the synoptic diagrams of features of the accepted species, including details of ascus plugs and ascospores. For each species, detailed descriptions and first-rate photographs are provided, with full information on all collections studied. Molecular sequence data, for 18S rDNA, is provided for five species. which suggests the genus is paraphyletic. Something which I found disconcerting. There are some other worrying items. The oxymoron '(Nitschke:Otth)' appears in a citation on p. 241 (how long will it take mycologists to properly implement the decisions of the 1981 International Botanical Congress?), and while *Helicogermslita celastri* is accepted on p. 238, on p. 220 its basionym is retained in *Amphisphaerella* !

Five new species are described in the genus, and the new genus *Appendixia* is introduced for *Anthostomella closterium* on the basis of the massive appendages and lack of a germ slit on the ascospores.

A host index is provided, and the extensive glossary includes welcome line drawings and photographs, although 'catenophyses' are illustrated photographically but lack an entry explaining them.

While this will not be the last word on the genus, not least because of collections the authors were not loaned, it is at a major step forward in our understanding of one of one of the most familiar genera of pyrenomycetes.

LICHEN-FORMING AND LICHENICOLOUS FUNGI

Lichens of North America. By Irwin M. Brodo, Sylvia D. Sharnoff and Stephen Sharnoff. 15 November 2001. Yale University Press, 302 Temple Street, P.O. Box 209040, New Haven, CT 06520-9040, USA. Pp. xxiii + 795. ISBN 0 300 08249 5. Price: US $ 69.95 (or US $ 48.97 on amazon.com !).

How many other books about lichens have received a full page feature story and review, including colour photographs, in a major daily newspaper like the *New York Times* (Tuesday, 1 January 2002, sect. F, p. 4) ? None as far as I know, although perhaps it shouldn't have been a surprise, since the publication of this wonderful new book and its numerous colour photographs is indeed a major milestone in North American natural history. Although its size and beautiful colour reproduction would certainly make it a suitable 'coffee table' book, it is also much more than that. Although the title and large size of this book might lead the uninitiated to expect a truly complete and comprehensive lichen biota for the North American continent, most of us know that this is still an unrealistic and unattainable goal for such a vast area. However, the authors' stated goal, which is to provide a full-colour guide to North American lichens that is accessible to the novice but useful as well for experienced lichenologists, is admirably achieved.

This book actually consists of two separate parts, the first dealing with general aspects of lichen biology and the second being a guide with keys for their identification . Part I, 'About the Lichens', consists of 14 succinct but informative chapters covering all the aspects of lichen form and biology necessary for a novice to use the identification guide. These occupy 113 pages and include chapters on: symbionts and symbiosis, morphology, reproduction, colours, physiology and growth, secondary chemistry, substrates, ecosystems, biogeography, human uses, environmental monitoring, classification, collection and study techniques, and hints on using the book and its keys.

Most of these chapters are fairly comprehensive and are well illustrated with beautiful colour photographs and excellent line-drawings, some of the latter being borrowed from other sources. In truth, Part I would be more than adequate, with supplementary readings, for use as a general textbook in an undergraduate class in lichenology. Also included, near the end of the book, is an excellent glossary, with the entries including references to illustrative plates or figures elsewhere in the text. An index to common and scientific names completes the volume, and here the binomials include the names of authorities, which are not used within the text itself.

The second part of this book, and the major reason for its preparation, is a 'Guide to the Lichens' of North America. This section leads off with artificial keys to the major groups and genera of lichens. These are necessarily artificial keys, grouping by major growth form and colour. With only limited testing, these seem to work very well. For each genus included, a brief but diagnostic description is given, and the number of species actually reported for North America is indicated, thus making easy the evaluation of the completeness of that genus' treatment and its key. Treatments of most crustose genera include only the more common or conspicuous species, reflecting the state of knowledge in most of those genera, whereas the treatments of macrolichen genera are much more comprehensive, but this also varies somewhat, depending in part on relative commonness and region of occurrence of the component species. For both crustose lichens and macrolichens, each species with its own entry is briefly described, both morphologically and chemically, with notes on habitat and comments on similar or easily confused species. For selected species, further comments on topics such as their usage by native or other peoples are also included. Each treated species also has its own distribution map, and more than 900 colour photographs, the heart of the book, are provided for 804 species. Although there may be some who would criticize the rather cumbersome large size format (9¼ x 11 ins), anything less would have been inadequate to showcase the often extraordinary photographs, many of which are rendered in half page or even full page layout.

Among others, this book is appropriately dedicated to Mason E. Hale jr, for his production of the first modern comprehensive guide to North American macrolichens (*How to*

Know the Lichens, 1969). In 1968, when I first became interested in lichen study, the only identification manuals available to me were Fink's posthumous 1935 *The Lichen Flora of the United States* and 'Lichens of the State of Washington' prepared by Grace Howard in 1950. Both of these contain only a handful of illustrations, and were woefully out of date. Since I also lacked access to a reference collection, my initial attempts at lichen determination were frustrating to say the least. I recall the publication of Mason's small, spiral bound and illustrated guide as a benchmark event, revitalizing and perhaps even rescuing my own slightly bruised interest in lichens. Through their dedication and perseverance over a fifteen year period, the authors of this marvelous new book have succeeded in making another quantum leap improvement over the previously available North American guides, and, if anything can, this book should help to stimulate a lichenological renaissance in North America.

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Lichens of Antarctica and South Georgia: a guide to their identification and ecology. By D.O. Øvstedal and R.I. Lewis Smith. June 2001. Cambridge University Press, The Edinburgh Building, Cambridge CB2 2RU, UK. Pp. xii + 411. ISBN 0 521 66241 9. Price £ 70.

This long-awaited book. It is undoubtedly a landmark in the development of our knowledge of Antarctic lichens. Actually, after the Dodge´s *Lichen Flora of the Antarctic Continent and adjacent Islands* (1973), no work that included the whole Antarctic area has been published. Redón´s *Liquenes Antarticos* (1985) can only be considered a manual describing in detail selected species, mainly those occurring in the South Shetland Islands, with little original information and additional herbarium research. On the other hand, Dodge's book, which includes more than 400 taxa, most of them Antarctic endemics, has been severely criticized, with up to half of his species being considered synonyms (Castello & Nimis 1995, 1997) of bipolar or cosmopolitan species already described from the Northern Hemisphere. During the last few years, the major invalidation of Dodge's checklist has supported the idea that the Antarctic lichen biota is much poorer than had been supposed, and that it would not include more than 200 taxa, very few of them being Antarctic endemics. The present book re-composes our image of Antarctic lichens placing them on a solid scientific base. Interestingly, the total number of Antarctic taxa returns to a figure of more than 400 (427 in total, 33.5 % Antarctic endemics, including 41 yet undetermined taxa), but this is just a coincidence with Dodge´s account.

In this book the authors carry out an excellent bibliographical review that includes the majority of papers published relating to Antarctic lichens, even those in languages other than English and in journals with very limited distributions. This is an enormously meritorious effort, which is specially welcome in Antarctic research, where international scientific co-operation is warmly encouraged. In the same way, there is an extensive study of collections of Antarctic lichens preserved in many herbaria in different parts of the world, including private collections. Bibliographical reviews and herbarium revisions are the mainstays that transmit an enormous solidity and originality to the whole work. On the other hand, the authors combine a lucky combination of long experience in taxonomy and in ecology, that is evident in the accuracy of the species description.

Nevertheless, this book is not only a systematic and ecological account of genera and species. The initial chapters on 'Environmental, Lichen Ecology', and 'History of Lichenological Investigations' are interesting and useful, updating of our knowledge of Antarctic lichens, although ecophysiological and microclimatic data are not included. The chapter on 'Biogeography and Diversity' is especially brilliant and original. The tables provided in this chapter summarize clearly current knowledge on lichen distribution in the different Antarctic regions. The 'Systematic Arrangement' is deliberately short and quite conservative. The authors avoid any phylogenetic discussion based on the very latest molecular data. Instead they focus on the elaboration of relatively simple but extremely useful keys, which are made up using an excellent selection of diagnostic characters, in many cases accompanied of drawings or good quality black and white pictures. It is a shame that the quality of the colour pictures provided in the central fold of plates do not honour the spectacular chromatic variety of many Antarctic lichens.

In spite of its great importance to our knowledge of the Antarctic lichens, or precisely because of it, this it is not a definitive work. It is evident that numerous Antarctic zones remain to be explored and that the level of knowledge across different genera is not homogeneous. Important genera such as *Rhizocarpon* and *Lecanora,* and many lecideoid groups, are still poorly known. This is the moment to encourage specialists throughout the world to focus on Antarctic lichens, which are much more diverse and specific in this region than we had once thought and that undoubtedly reserve numerous surprises for future investigators.

Castello, M. & Nimis, P. L. (1995) A critical reassessment of Antarctic lichens described by C. W. Dodge. *Bibliotheca Lichenologica* 57: 71-92.

Castello, M. & Nimis, P. L. (1997) Diversity of lichens in Antarctica. In *Antarctic Communities: species, structure and survival* (G. di Prisco, S. Focardi & P. Luprorini, eds): 147-155. Camerino University Press, Camerino.

Dodge, C. W. (1973) *Lichen Flora of the Antarctic Continent and adjacent Islands*. Phoenix, Canaan, New Hampshire.

Redón J. (1985) *Líquenes Antarticos*. INACH, Santiago de Chile.

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Checklist of the Lichens and Lichenicolous Fungi of the Iberian Peninsula and Balearic Islands. By Xavier Llimona & Néstor Hladun. 10 September 2001. Hebarium Mediterraneum Panormitanum, Dipartimento de Scienze Botanische dell'Universita, Via Archirafi 28, I-90123 Palermo, Italy. [Bocconea No. 14.] Pp. 581. ISBN 88 7915 014 6, ISSN 1120-4060. Price:□ 55.

The Iberian Peninsula has witnessed a remarkable resurgence of interest in lichens and not least their lichenicolous fungi over the last three decades. The history of lichenological studies in the area is described and various waves distinguished, the pioneers of the new wave being identified as Ana Crespo, Xavier Llimona, Eva Barreno and R. Carballal. There have been numerous regional studies and systematic accounts of different groups since this revival started, but a synthesis and route into what was becoming a huge body of literature was sorely needed. The checklist is based on a screening of 1587 publications, and results in a list of 2794 accepted infrageneric taxa, of which 2426 are lichens and 368 lichenicolous fungi. For each taxon treated, there is a full list of references to works citing it from the region, with the synonyms (if any) used. There is also an index to binomials which the compilers say contains an amazing 7381 names; an index by epithet would have been icing on the cake but might be considered for future editions. The whole has been made as comprehensive as possible, including publications back to Acharius, Brotero and Clemente in the first decade of the nineteenth century. This means that it 'traces the path towards a treasure of "concealed", overlooked, or simply forgotten information'. Amongst the forgotten information are 16 pages of names for which no modern name has been found. In this undertaking, the compilers have been assisted not only by many of the leading specialists in the region, but other specialists in Europe and elsewhere who have been sent drafts to comment on. It is very much a collective effort, and one published under the OPTIMA umbrella, constituting Publication No. 4 of the OPTIMA Commission for Lichens.

Such works have to have a cut-off date or they would never be completed. In this case, the literature is covered to the end of 1999, so there are already many additions to be made. Nonetheless, this is a pivotal publication for the region that will be of value to all working on monographs of different groups in the region, and also to the numerous lichenologists who take 'busman's' holidays to Portugal, Spain and the Balearic islands.

Taxonomy and Phylogeny of *Dermatocarpon* (*Verrucariales,* lichenized *Ascomycotina*) with special emphasis on the Nordic Species. By Starri Heiðmarsson. 3 October 2000. University of Uppsala. [Comprehensive Summaries of Uppsala Dissertations from the Faculty of Science and Technology No. 555.] Pp. 126, ISBN 91 554 4762 7. Price: Not indicated.

This doctoral dissertation tackles an extremely difficult lichenized genus by bringing molecular analyses to bear on the problem, although the author has had some difficulties in reconciling what he saw morphologically with the molecular evidence in the *Dermatocarpon miniatum* complex. The first modern keys to 14 species are presented, including the aquatic species which have been poorly understood in most parts of Europe. This work will certainly result in a better recording of the genus in the future, which is of especial importance as some of the species may be unable to grow where waters are polluted. Papers already published, in press, or to be submitted are included in the volume. If you can't get access to this work, watch for the author's name in future issues of mycological (and lichenological) journals.

Líquens Epífits i Fongos Liquenícoles del Sud de Catalunya. By Montserrat Boqueras. 2000. Institut d'Estudis Catalans, Carrer del Carme 47, Barcelona 08001, Spain. [Arxius de les Seccions de Ciéncies, Secció de Ciénciès Biològiques No. 127.] Pp. 556. ISBN 84 7283 549 9. Price: Not indicated.

A detailed survey based on studies in 97 localities distributed over 2500 km^2 in southern Catalonia (north-east Spain), also including treatments of the communities as well as of the species present. In all, 340 taxa were found, of which 48 were lichenicolous. Unusually for such works, descriptive notes are provided for all species as well as information on chemistry, ecology, distribution, and specimens examined. The descriptive data icludes the first accounts of some species which seem to be new but are not formally described here (e.g. an *Abrothallus* with part spores on a *Lecanora*). Keys are included to species within some but not all genera and groups, and numerous line drawings, of asci and ascospores in particular, are provided where these are critical for identification. The phytosociological communities present have been analyzed in depth, with quadrat data presented, and there are also lists of species known from particular trees. This work, carried out under the supervision of Professor A. Gómez-Bolea, continues the fine tradition of regional lichen studies in the Iberian peninsula which are making this one of the best documented parts of Europe for lichens.

Lichenicolous Fungi of the Czech Republic (the first commented checklist). By Jana Kocourková. November 2000. Národní Muzeum, Praha, Czech Republic. [Acta Musei Nationalis Pragae, Series B, Historia Naturalis, Vol. 55 (3-4).] Pp. 110. ISSN 0036-5343. Price: Not indicated.

This checklist includes 156 species, 70 not previously reported from the country. Keys and descriptions are not included, but detailed information is provided not only about the Czech collections but also on other known hosts and world distributions. Microphotographs of some 21 species are included, including several not previously illustrated photographically in print. In view of the extensive literature citations, this is a work all who study these fungi will wish to have on their shelves.

BASIDIOMYCETES

Introduzione allo studio del genre *Ramaria* in Europa. By Paola Franchi & Mauro Marchetti. 30 July 2001. Libreria Mykoflora, di Maria Teresa Basso, Via Ottone Primo 90, I-17021 Alassio-Moglio (SV), Italy. [Fungi non Delineati raro vel haud perspecte et explorate descripti aut definite picti No. 16.] Pp. 104. ISSN 1128-6008. Price:□ 14.46.

Few mycologists have dared to venture in Corner's footsteps with respect to the clavarioid fungi. This work shows that each generation of mycologists stands on the shoulders of its forebears, but by so doing can see further. Following an overview of the characters used in separating taxa in the genus, keys to subgenera and sections follow. Three subgenera are recognized, *Echinoramaria* (with two sections), *Lentoramaria* (with two sections), and *Ramaria* (with ten sections). In none of the subgenera, does one of the sections use the name of the subgenus, creating some nomenclatural confusions: *R.* subgen. *Ramaria* sect. *Botrytes* should be sect. *Ramaria, R.* subgen. *Echinoramaria* sect. *Grandispora* should be sect. *Echinoramaria,* and *R.* subgen. *Lentoramaria* sect. *Strictae* should be sect. *Lentoramaria.* Keys to the species are provided, and there are tables giving colour reactions with a wide range of reagents which should prove especially useful. More detailed accounts are provided of particular species, and first-rate colour photographs of most species are included. Especially welcome is an English translation of the keys down to species level, and also the line drawings of the basidiospores. Sadly, the citations in the keys indicate that the authors do not appreciate that when referring to infraspecific taxa, the correct and only author citation is that after the infraspecific taxon name and no author citation should be present after the species name, except where the varietal name is the same as that of the species. Despite the minor nomenclatural gaffs, this work needs to sit on the shelf beside Corner's monograph and be used by all endeavouring to identify these fascinating fungi, not only in Europe but also world-wide.

Rare, debated and new taxa of the genus *Cortinarius* (*Agaricales*). By Meinhard Moser. 30 July 2001. Libreria Mykoflora, di Maria Teresa Basso, Via Ottone Primo 90, I-17021 Alassio-Moglio (SV), Italy. [Fungi non Delineati raro vel haud perspecte et explorate descripti aut definite picti No. 15.] Pp. 57. ISSN 1128-6008. Price:□ 8.26.

This work deals with a range of new and critical species, mainly from Europe but also with some new species from North America. Newly described are: *C. angelesianus* var. *elakatopus* var. nov. (type from Austria), *C. citrinofulvescens* sp. nov. (type from Austria), *C. cyanides* var. *fuscoornatus* var. nov. (type from Austria), C. *montanus* var. *fuliginerofolius* var. nov. (type from California), *C. montanus* var. *fageticola* comb. nov., *C. pseudocompar* sp. nov. (type from Finland), *C. scaurus* f. *phaeophyllus* (type from Finland). Also discussed are: *C. absarokensis, C. atrocoeruleus, C. blattoi, C. compar, C. detonsus, C. fagetorum, C. grallipes, C. herpeticus, C. ionophyllus, C. laetissimus, C. laetus, C. montanus, C. multicolor, C. pseudobovinus, C. scaurus, C. scutulatus,* and *C. sytnikii.* The accounts are illustrated by fine coloured paintings and also line drawings of basidiospores and where appropriate the pilleipellis features. Undoubtedly another authoritative contribution to our knowledge of this speciose and poorly understood genus.

Setas de Colombia (*Agaricales, Boletales* y otros hongos). By A. Esperanza Franco-Molano, R. Aldana-Gómez & R. E. Halling. 2000. Colciencias, Universidad de Antioquia, Departamento de Publicaciones, Ciudad Universitaria, Bloque 28 Oficina 233, Apartado 1226, Medellín, Colombia. Pp. 156. ISBN 958 655 457 2. Price: Not indicated.

Identification aids are a key to encouraging mycologists in countries whose fungi are as yet hardly explored. This pocket-sized book covers 100 species, all illustrated by colour photographs, together with detailed descriptions including microscopic features, references to the primary literature, citations of more modern and accessible works with descriptions where they exist, and notes on habitat and distribution. Information on edibility and toxicology is included, and there is a glossary with line drawings showing gill and basidiospores types, etc. While this little book necessarily only scratches at the surface and species not covered will be easily found, it should do much to stimulate the critical study of macromycetes in the country.

MISCELLANEOUS

Atlas of Clinical Fungi. By G. S. de Hoog, J. Guarro, J. Gené & M. J. Figueras. November 2000. 2nd edition. Centraalbureau voor Schimmelcultures, P. O. Box 85167, 3508 AD Utrecht, The Netherlands. Pp. 1126. ISBN 90 70351 43 9. Price:□ 95.

It is a pleasure to welcome this new edition of this now well-established book which first appeared in 1995 and ran to 'only' 720 pages. The cover is the same, with the fine scanning electron micrographs of *Chaetomium funicola* peridial hairs which are almost a hall-mark of the book – but now they are greenish so the editions are easily distinguished. The double-page per species format is retained, most being occupied by a combination of line drawings and photomicrographs, often taken with interference contrast, and also scanning electron micrographs. The information given on each species has, however, been extended significantly. In addition to descriptive notes, information on pathogenicty, and literature references, the new edition has extra features under each species that make it even more valuable and very much a book of the 21st century: Biosafety Level classification, antifungal susceptibility data, molecular data including trees and where available rDNA SSU restriction maps, and physiological profiles for filamentous fungi as well as yeasts. Actual bibliographic nomenclatural references to both accepted names and cited synonyms are also added this time. Further, more species are included, especially yeasts and opportunists, making a total of about 400. Also new is a 21 page small-type index of doubtful names and unconfirmed clinical cases which substantially adds to the value of the work as a one-stop shop for the clinical mycologist. The list of references extends to an amazing 64 pages compared with only 35 pages in the 1995 edition, and the index to scientific names now has a staggering 3400 plus fungal names – listed by epithet as well as by generic name which greatly facilitates retrieval. It is hard to fault such a tried and tested work which has been so skillfully updated to bring it into tune with current knowledge and concerns,. but in the third edition why not extend the methods sections at the front of the work with more illustrations of procedures to make it even more a self-contained reference work ? Medical mycology is hardly short of identification manuals, but there are no others in this class – and for such a reasonable price. Indeed, so many fungi are included and so beautifully illustrated, that the work merits purchase by all dealing with fungi in culture, not least ecologists working with soil fungi. Make sure there is a copy around in your graduate students' laboratory even if you do not consider yourself a medical mycologist !

Soil Microfungi of Israel. Edited by C. V. Subramanian & S. P. Wasser. November 2001. A. R. G. Ganter Verlag Kommandit Gesellschaft, FL 9491 Ruggell, Liechtenstein. [Distributed by: Koeltz Scientific Books, Herrnwaldstrasse 6, D-61462 Königstein, Germany.] Pp. iv + 545, pl. 62. ISBN 3 904144 76 6. Price: Not indicated.

This book is part of a series on *Biodiversity of Cyanobacteria, Algae and Fungi of Israel.* Edited by two distinguished and well-known mycologists, the authors are given as P. A. Volz, A. Ellanskaya, I. Grishkan, S. P. Wasser and E. Nevo. It is thus the result of a collaboration between Israeli scientists and mycologists from the USA and Ukraine. The book treats a staggering 444 species belonging to 129 genera, and for each provides lists of synonyms, references to literature with descriptions, a description of the cultural features, microscopic measurements, information on reports from the country, notes on world distribution, and in some cases other notes. There are no keys, even to genera or to species even in large genera such as *Penicillium*. There are no illustrations in the main body of the text, but a substantial set of plates mainly made up of half-tone photographs but including some lime drawings preceeds the index. The quality of the illustrations is somewhat disappointing and it is unfortunate that the colony characteristics could not be presented in colour and that the authors evidently lacked access to microscopes fitted with intereference or phase contrast optics.

There is a short section on techniques, and a survey of the mycobiota to be found in different regions of Israel, but no comparisons with other areas of the world where similar compilations have been made.

While this book unquestionably represents a great leap forward in our knowledge of Israeli soil fungi that can be cultured, 147 of the species being new reports for the country, it has to be compared with A. H. Moubasher's *Soil Fungi in Qatar and other Arab Countries* (Moubasher 1993) – a work not even mentioned in the otherwise extensive list of references. That work is of an almost identical length (566 pp.), has just over half the number of species, but includes keys down to species, colour photographs of cultures, and is lavishly illustrated with photomicrographs – many taken with phase contrast. If I had to recommend a book to students or ecologists wishing to work with soil fungi in the Middle-East, because of these features Moubasher's would have to be the favourite.

Moubasher, A. H. (1993) *Soil Fungi in Qatar and other Arab Countries.* Doha, Quatar: Centre for Scientific and Applied Research, University of Qatar.

MYCOTAXON

Volume LXXXII, pp. 489-490 April-June 2002

INSTRUCTIONS TO AUTHORS: important changes and updates

SUBMISSION package must include

☑ Cover letter always including a statement on acceptance or rejection of any of the reviewer's comments.

☑ Camera-ready copy.

☑ Copy of camera-ready manuscript for indexing.

☑ Both reviewers' comments AND reviewer's checklist.

☑ Floppy disc with formatted text of the paper. **NEW REQUIREMENT.**

Before mailing the paper to *Mycotaxon* compare the Author's checklist (upgraded version on next page).

ABSTRACT

Abstracts are required for all articles exceeding two printed pages in length. The abstract should be brief but informative, should include all newly proposed names, and should be no more than 15 printed lines long. Do not include authorities for taxa (unless they are necessary to distinguish homonyms). A second abstract in another language is still permitted.

KEY WORDS

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In connection with the prestigious HighWire Press of Stanford University, the Mycological Society of America is pleased to announce that their journal Mycologia is now available on-line at http://www.mycologia.org/.

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JIM GINNS, Managing Editor, Mycologia

NOMENCLATURAL NOVELTIES PROPOSED IN MYCOTAXON VOLUME 82

Alternaria ellipsoidea E. G. Simmons, p. 31
Alternaria juxtiseptata E. G. Simmons, p. 32
Alternaria nobilis (Vize) E. G. Simmons, p. 7
Alternaria subelliptica E. G. Simmons, p. 36
Alternaria vaccariae (Săvul. & Sandu) E. G. Simmons & S. Koike, p. 21
Amandinea cacuminum (Th. Fr.) H. Mayrhofer & Sheard, p. 438
Anthracoidea pygmaea L. Guo, p. 147
Argopericonia indiraei D'Souza, S. K. Singh & Bhat, p. 135
Arthothelium diffluens (Nyl.) Imshaug & Fryday, p. 422
Ascochyta peperomiae J. M. Pereira & R. W. Barreto, p. 369
Byssothecium cholla M. E. Barr, p. 380
Byssothecium obiones (P. Crouan & H. Crouan) M. E. Barr, p. 378
Chaetomastia cactorum (Earle) M. E. Barr & Boise, p. 381
Coccotrema corallina Messuti, p. 430
Coccotrema fernandeziana Messuti, p. 431
Coccotrema magellanica Messuti, p. 432
Contumyces Redhead, Moncalvo, Vilgalys & Lutzoni, p. 161
Contumyces brunneolilacina (Contu, M. Bon & Curreli) Redhead, Moncalvo, Vilgalys & Lutzoni, p. 162
Contumyces rosella (M. M. Moser) Redhead, Moncalvo, Vilgalys & Lutzoni, p. 161
Contumyces vesuviana (Briganti) Redhead, Moncalvo, Vilgalys & Lutzoni, p. 162
Dictyosporium musae Photita, p. 416
Haplotrichum armeniacum (Berk. & M. A. Curtis) Partridge & Morgan-Jones, p. 44
Haplotrichum croceum (Mont.) Partridge & Morgan-Jones, p. 51
Haplotrichum laevisporum (Cooke) Partridge & Morgan-Jones, p. 63
Haplotrichum morganii (Linder) Partridge & Morgan-Jones, p. 70
Haplotrichum ponderosum Partridge & Morgan-Jones, p. 75
Haplotrichum pulveraceum (Ellis) Partridge & Morgan-Jones, p. 79
Immotthia atroseptata (Piroz.) M. E. Barr, p. 383
Loreleia Redhead, Moncalvo, Vilgalys & Lutzoni, p. 162
Loreleia marchantiae (Singer & Clémençon) Redhead, Moncalvo, Vilgalys & Lutzoni, p. 162
Loreleia postii (Fr.) Redhead, Moncalvo, Vilgalys & Lutzoni, p. 162
Loreleia roseopallida (Contu) Redhead, Moncalvo, Vilgalys & Lutzoni, p. 162
Mycosphaerella daviesicola Beilharz & Pascoe, p. 364
Nitschkia parasitans var. *mijuskovicii* Vujanovic, p. 123
Phacellium stephanandricola H. D. Shin & J. D. Kim, p. 459
Phaeophleospora atkinsonii (Syd.) Pennycook & McKenzie, p. 145
Phialoocephala vittalensis D'Souza, S. K. Singh & Bhat, p. 137
Pouzarella caribaea T. J. Baroni & B. Oritz, p. 276
Pseudocercospora hopetounensis Beilharz & Pascoe, p. 402
Pseudocercospora kennediicola Beilharz, Pascoe & Parbery, p. 397
Pseudocercospora warcupii Beilharz, Pascoe & Parbery, p. 400
Pseudopaulia M. Schultz, p. 446
Pseudopaulia tessellata M. Schultz, p. 446

Ramboldia petraeoides var. *concava* (Müll. Arg.) Fryday, p. 423
Rhexoacrodictys W. A. Baker & Morgan-Jones, p. 98
Rhexoacrodictys erecta (Ellis & Everh.) W. A. Baker & Morgan-Jones, p. 99
Rhexoacrodictys fimicola (M. B. Ellis & Gunnell) W. A. Baker & Morgan-Jones, p. 103
Rhexoacrodictys fuliginosa (B. Sutton) W. A. Baker & Morgan-Jones, p. 106
Rhexoacrodictys queenslandica (Matsush) W. A. Baker & Morgan-Jones, p. 110
Russula xerampelina var. *tenuicarnosa* Adamčík, p. 263
Sinodidymella americana M. E. Barr, p. 384
Sinodidymella hesperia M. E. Barr, p. 385
Sinodidymella utahensis (Petr.) M. E. Barr, p. 384
Speiropsis rogergoosensis Kesh. Prasad & Bhat, p. 127
Sphagnomphalia Redhead, Moncalvo, Vilgalys & Lutzoni, p. 162
Sphagnomphalia brevibasidiata (Singer) Redhead, Moncalvo, Vilgalys & Lutzoni, p. 163
Sporidesmium subfuscum Marvanová & Gulis, p. 451
Stemphylium bubakii E. G. Simmons, p. 18
Stemphylium trisectum (A. Raabe) E. G. Simmons, p. 25
Stratiphoromyces raghukumarensis D'Souza, S. K. Singh & Bhat, p. 139
TEICHOSPORACEAE M. E. Barr, p. 374
Trechispora antipus Trichies & Schultheis, p. 453
Urocystis qinghaiensis L. Guo, p. 148
Verrucisporota daviesiae (Cooke & Massee) Beilharz & Pascoe, p. 360
Verrucisporota kimberleyana Beilharz & Pascoe, p. 358
Virgatospora natarajanensis D'Souza, S. K. Singh & Bhat, p. 141

AUTHOR INDEX, VOLUME EIGHTY-TWO

Adamčík, Slavomír. Taxonomy of the *Russula xerampelina* group. Part 2. Taxonomic and nomenclatural study of *Russula xerampelina* and *R. erythropoda*, 82: 241-267, 2002.

Anderson, J. L., & C. A. Shearer. *Halosarpheia heteroguttulata:* anamorph and report from the Northern Hemisphere, 82: 115-120, 2002.

Aparicio, Armando, see Esqueda & al.

Baker, William A., E. Christopher Partridge, & Gareth Morgan-Jones. Notes on Hyphomycetes LXXXVII. *Rhexoacrodictys,* a new segregate genus to accommodate four species previously classified in *Acrodictys,* 82: 95-113, 2002.

Baker, William A., see Partridge & al.

Baroni, Timothy J., & Beatriz Ortiz. New species of *Oudemansiella* and *Pouzarella* (Basidiomycetes: Agaricales) from Puerto Rico, 82: 269-279, 2002.

Barr, Margaret E. Teichosporaceae another family in the Pleosporales, 82: 373-389, 2002.

Barreto, Robert Weingart, see Pereira & Barreto

Beilharz, Vyrna, & Ian Pascoe. Two new species of *Verrucisporota*, one with a *Mycosphaerella* teleomorph, from Australia, 82: 357-365, 2002.

Beilharz, Vyrna, I. G. Pascoe, & D. G. Parbery. Three new *Pseudocercospora* species, one with a *Mycosphaerella* teleomorph, from *Kennedia* in Australia, 82: 397-407, 2002.

Bhat, D. J., see D'Souza & al.

Bhat, D. J., see Keshava Prasad & Bhat

Bigelow, Donna M., see Gilbertson & al.

Castillo, A., G. Moreno, C. Illana, & H. Singer. Notes on two violet species belonging to Physarales (Myxomycetes), 82: 347-356, 2002.

Cavalcanti, Laise de Holanda, see Góes-Neto & Cavalcanti

Cifuentes, Joaquín, see Sandoval & al.

Clark, Jim, Martin Schnittler, & Steven L. Stephenson. Biosystematics of the myxomycete *Arcyria cinerea*, 82: 343-346, 2002.

D'Souza, Maria, Sanjay K. Singh, & D. J. Bhat. New conidial fungi from Andaman Islands, India, 82: 133-143, 2002.

Desjardin, Dennis E., see Gilbertson & al.

Dimou, Dimitrios M., Georgios I. Zervakis, & Elias Polemis. Mycodiversity studies in selected ecosystems of Greece: I. Macrofungi from the southernmost *Fagus* forest in the Balkans (Oxya Mountain, central Greece), 82: 177-205, 2002.

Esqueda, Martín, Teófilo Herrera, Evangelina Pérez-Silva, Armando Aparicio, & Gabriel Moreno. Distribution of *Battarea phalloides* in Mexico, 82: 207-214, 2002.

Ferraro, Lidia I, see Messuti & Ferraro

Fryday, Alan M.. New combinations and records of lichenized-fungi from southern South America, 82: 421-428, 2002.

García-Sandoval, Ricardo, Margarita Villegas, & Joaquín Cifuentes. New records of *Ramariopsis* from Mexico, 82: 323-333, 2002.

Gilbertson, Robert L., Donna M. Bigelow, Don E. Hemmes, & Dennis E. Desjardin. Annotated check list of wood-rotting Basidiomycetes of Hawai'i, 82: 215-239, 2002.

Ginns, Jim. Mycologia online site is launched, 82: 491, 2002.

Góes-Neto, Aristóteles, & Laise de Holanda Cavalcanti. Myxomycetes of the state of Bahia, Brazil: historical review and current situation, 82: 335-342, 2002.
Gulis, Vladislav, see Marvanová & Gulis
Guo, Lin. Two new species of Ustilaginomycetes and a species knew to China, 82: 147-150, 2002.
Hawksworth, David L. Book reviews and notices, 82: 475-487, 2002.
Hemmes, Don E., see Gilbertson & al.
Herrera, Teófilo, see Esqueda & al.
Ho, H. H. *Phytophthora cinnamomi* var. *robiniae* var. nova on black locust in Jiangsu province of China, 82: 391-396
Hyde, K. D., see Photita & al.
Illana, C., see Castillo & al.
Jung. Hack Sung, see Kim & Jung
Jung. Hack Sung, see Ko & Jung
Keshava Prasad, T. S., & D. J. Bhat. *Speiropsis rogergoosensis* sp. nov. from India, 82: 127-131, 2002.
Kim, Jeong-Dong, see Shin & Kim
Kim, Seon-Young, & Hack Sung Jung. Cladistic analysis of the Polyporaceae using morphological characters, 82: 295-314, 2002.
Ko, Kwan Soo, & Hack Sung Jung. Phylogenetic evaluation of *Polyporus* s. str. based on molecular sequences, 82: 315-322, 2002.
Lechner, Bernardo E., & Jorge E. Wright. First record of *Neolentinus schaefferi* in the Americas, 82: 281-287, 2002.
Liu, Pei-Gui, Xiang-Hua Wang, Fu-Qiang Yu, & Huan-Di Zheng, The Hypocreaceae of China IV. Some new records of the genus *Hypocrea* from China, 82: 463-474, 2002.
Lumyong, P., see Photita & al.
Lumyong, S., see Photita & al.
Lutzoni, François, see Redhead & al
Marvanová, Ludmila, & Vladislav Gulis. A new name for *Sporidesmium fuscum* Gulis & Marvanová, 82: 451, 2002.
Mayrhofer, H., & J. W. Sheard. *Amandinea cacuminum:* a new combination (Physciaceae, lichenized Ascomycetes), 82: 437-441, 2002.
McKenzie, E. H. C., see Pennycook & McKenzie
McKenzie, E. H. C., see Photita & al.
Messuti, María Inés. New species of the lichen genus *Coccotrema* from southern South America, 82: 429-435, 2002.
Messuti, María Inés, & Lidia I. Ferraro. Notes on two corticolous lichens from South America, 82: 409-413, 2002.
Moncalvo, Jean-Marc, see Redhead & al.
Moreno, G., see Castillo & al.
Moreno, Gabriel, see Esqueda & al.
Morgan-Jones, Gareth, see Baker & al.
Morgan-Jones, Gareth, see Partridge & al.
Ortiz, Beatriz, see Baroni & Ortiz
Parbery, D. G., see Beilharz & al.
Partridge, E. Christopher, see Baker & al.

Partridge, E. Christopher, William A. Baker, & Gareth Morgan-Jones. Notes on Hyphomycetes. LXXXVI. Some additional *Haplotrichum* species, with supplementary comments on, and a key to, the genus, 82: 41-94, 2002.

Pascoe, I. G. see Beilharz & al.

Pascoe, Ian, see Beilharz & Pascoe

Pennycook, S. R., & E. H. C. McKenzie. *Scoleciasis atkinsonii,* an earlier name for *Phaeophleospora hebes,* and a note on G. H. Cunningham's epithets *hebe* and *pseudopanax,* 82: 145-146. 2002.

Pereira, José Mauricio, & Robert Weingart Barreto. A new species of *Ascochyta* from leaf spots on *Peperomia* spp. in Brazil, 82: 367-372, 2002.

Pérez-Silva, Evangelina, see Esqueda & al.

Photita, W., P. Lumyong, E. H. C. McKenzie, K. D. Hyde, & S. Lumyong. A new *Dictyosporium* species from *Musa acuminata* in Thailand, 82: 415-419, 2002.

Polemis, Elias, see Dimou & al.

Redhead, Scott A., Jean-Marc Moncalvo, Rytas Vilgalys, & François Lutzoni. Phylogeny of agarics: partial systematics solutions for bryophilous omphalinoid agarics outside of the Agaricales (euagarics), 82: 151-168, 2002.

Schnittler, Martin, see Clark & al.

Schultheis, Ben, see Trichies & Schultheis

Schultz, Matthias. *Pseudopaulia tessellata,* a new genus and species in the Lichinaceae (lichenized Ascomycotina) from Socotra, Yemen, 82: 443-449, 2002.

Sheard, J. W., see Mayrhofer & Sheard

Shearer, C. A, see Anderson & Shearer

Shin, Hyedon-Dong, & Jeong-Dong Kim. *Phaceliium stephanandricola* sp. nov. on *Stephanandria*, 82: 459-462, 2002.

Simmons, Emory G. *Alternaria* themes and variations (287-304). Species on Caryophyllaceae, 82: 1-40, 2002.

Singer, H., see Castillo & al.

Singh, Sanjay K., see D'Souza & al.

Stephenson, Steven L., see Clark & al.

Trichies, Gérard, & Ben Schultheis. *Trechispora antipus* sp. nov., une seconde espèce bisporique du genre *Trechispora* (Basidiomycota, Stereales), 82: 453-458, 2002.

Vilgalys, Rytas, see Redhead & al.

Villegas, Margarita, see Sandoval & al.

Vizzini, Alfredo, & Mirca Zotti. *Favolaschia calocera,* a tropical species collected in Italy, 82: 169-176, 2002.

Vujanovic, Vladimir. A new variety of *Nitschkia parasitans* hyperparasitic on *Nectria cinnabarina* from American beech, 82: 121-125, 2002.

Wang, Xiang-Hua, see Liu & al.

Wright, Jorge E., see Lechner & Wright

Wu, Sheng-Hua. New records of the Corticiaceae from mainland China, 82: 289-294, 2002.

Yu, Fu-Qiang, see Liu & al.

Zervakis, Georgios I., see Dimou & al.

Zotti, Mirca, see Vizzini & Zotti

Zheng, Fu-Quiang, see Liu & al.

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME EIGHTY-TWO

This index includes names of genera, infrageneric taxa, species, and infraspecific taxa, as well as new names of suprageneric taxa. All new names are in CAPITALS. The page number on which a new name is proposed is followed by an asterisk (*).

Aaosphaeria 375
Abortiporus
  biennis 298, 303-304
Acladium 90
  capitatum 91
Acrodictys 95-97, 108, 111-112
  atroapicula 96
  bambusicola 96-97
  elaeidicola 96
  erecta 95-97, 100, 102
  excentrica 108, 111-112
  fimicola 95-97, 103
  fuliginosa 95-97, 106, 108
  queenslandica 95, 97, 110
  sacchari 95-96, 103-104, 106-107
  satwalekeri 95, 97, 100, 102
  septosporioides 111
  triarmatus 111-112
Aecidium
  hebe 146
Agaricus
  arvensis 182, 201
  bisporus
    var. bisporus 182, 201
  campestris 182, 200-201
  cupreobrunneus 182
  excellens 182
  integer "beta" 245
  langei 182
  macrosporus 182, 200-201
  mediofuscus 182, 200-201
  pampeanus 182, 200-201
  postii 151, 162
  silvicola 200
  tinctorius 243
  vesuvianus 162
  xerampelinus 242-243, 247, 259
Agrocybe
  parasitica 220
  praecox 182, 200-201
Albatrellus 309
  ovinus 298, 303-304, 308
Aleurobotrys
  botryosus 220
Aleurocystis
  magnispora 220
Aleurodiscus 172, 289
  disciformis 289-290
  mirabilis 220
  monilifer 289-290
Allescheriella 41-42, 54-56
  crocea 42, 50-51, 54
  uredinoides 42, 51, 55
Alternaria 1-2, 7, 10, 12-16, 20-21, 26, 31, 34, 37-38
  alternata 12
  brassicae
    var. dianthi 20
  congesta 13-14
  dianthi 1, 3, 7, 10, 15-16, 20
  dianthicola 10, 26-28, 38
  ELLIPSOIDEA 1, 31*-32, 33, 38
  gypsophilae 16, 28-30, 32, 38
  JUXTISEPTATA 1, 32*, 34-35, 38
  longispora 15-17, 38
  NOBILIS 1, 3, 7*-11, 15-16, 20, 26, 29, 32, 38
  radicina 14
  saponariae 2-7, 11, 16, 21, 29, 32, 38
  SUBELLIPTICA 1, 36*-38
  tenuis 12-13
  tenuissima 15
  VACCARIAE 1, 21*-24, 32, 38
Alysidium 90
Amandinea 437, 440
  CACUMINUM 437, 438*-439
  crassiuscula 437
  insperata 437
  petermannii 437
  punctata 440

Amanita
  aspera 182
    var. franchetii 182
  battarae 182
  franchetii 182, 200-201
  muscaria 182, 201
  submembranacea 182, 200-201
Amarenomyces
  ammophila 381
Amethicium
  chrysocreas 220
Amphididymella
  verrucosa 384
Amphinema
  byssoides 220
Amphisphaeria
  confertissima 383
  deformata 383
  hypoxylon 382-383
  pilosella 383
Amylocystis
  lapponicus 298, 303
Anaeromyces 410
Anema
  nummularium 444, 448
Anomoporia
  albolutescens 298
  bombycina 298, 303
Anthracoidea 147-148
  elynae 148
  filifoliae 148
  linderbergiae 147-148
  PYGMAEA 147*-148
  smithii 147-148
Antrodia 304
  albida 220
  carbonica 298, 303-304
  gossypina 220
  malicola 220
  odora 220
  sinuosa 220
  vaillantii 229
Antrodiella 307
  incrustans 220
  semisupina 298, 303, 305
Arachnophora 111
  excentrica 111
  fagicola 111
Arctopeltis
    thuleana 439
Arcyria 335, 341, 343
  cinerea 337, 340, 343, 345-346
  denudata 337, 340
  digitata 337
  globosa 337
  incarnata 337
  insignis 340
  oerstedii 337
  pomiformis 337, 343, 345-346
  versicolor 337
Argopericonia 137
  elegans 137
  INDIRAEI 133-135*, 137
Argyroxiphium
  sandwicense 104
Armillaria 183, 201, 216, 273
  gallica 182, 201-202
  mellea 183, 201, 216
  ostoyae 221
  sinapina 220
Arthonia 422
Arthothelium 421-423
  DIFFLUENS 421, 422*-423
  evanescens 423
Ascochyta 367, 371
  PEPEROMIAE 367, 369*
    371-372
  piperina 371
Asterophora 72
Asterostroma
  cervicolor 221
  muscicolum 221
  ochroleucum 221
  praeacutisporum 221
Athelia
  arachnoidea
    var. arachnoidea 221
  bambusae 221
  cibotii 221
  epiphylla 221
  pyriformis 221
Auricularia 216
  cornea 221
  polytricha 155-156, 221
  tenuis 221
Auriporia
  aurea 298, 303
Auriscalpium 172

Australiaena 437

Basidiodendron
  caesiocinerea 221
  cinerea 221
  eyrei 221
  fulvum 221
Basidioradulum 154
  radula 156
Battarrea 207, 211-213
  phalloides 207-209
  stevenii 207, 212
Battarreoides
  diguetii 212
Bertia 376
Bertiella 376
  macrospora 376-378
  rhodospila 377
Biatora
  ceroplasta 411
Biscogniauxia
  nummularia 180, 201
Bisporella
  citrina 180, 201
Bjerkandera 310
  adusta 183, 201, 298, 303, 310
Boidinia
  granulata 289, 291
Boletopsis 296
Boletus
  Sect. Calopodes 183
  calopus 202
  edulis 183, 201
  radicans 183, 200-201
  relipes 156
  reticulatus 183, 200-201
Bondarzewia 306
Botryobasidium 41-42, 55, 60, 90
  Subg. Brevibasidium 59
  ampullatum 221
  botryosum 59-60, 221
  candicans 59, 91, 221
    var.latispora 42
  coronatum 59
  croceum 42, 52
  curtisii 43, 59-60
  danicum 60
  ellipsosporum 62
  latisporum 42, 88
  lembosporum 60
  longisporum 88
  medium 68
  ponderosum 42, 55, 72
  pruinatum 59, 221
  vagum 59-60, 226
Botryohypochnus
  isabellinus 177, 183, 200-202, 221
Botrytis
  capitata 91
  coccotrichoidea 51
Bourdotia
  aspera 221
  kipukaensis 221
  petiolata 222
Bovista
  nigrescens 183, 200-201
  plumbea 183, 200-201
Brevicellicium
  olivascens 222
  vulcanense 222
Buellia 423, 437, 439
  Sect. Melanaspicilia 439
Byssolophis 375
Byssoporia
  terrestris 177, 183, 200-202
Byssosphaeria 383
Byssothecium 373, 376-378, 380
  alpestris 378, 380
  CHOLLA 373, 378, 380*
  circinans 377, 380
  flumineum 378, 380
  OBIONES 378*, 380

Caecomyces 410
  communis 413
Callistosporium
  luteoolivaceum 222
Calocera
  cornea 183, 201, 221
  furcata 222
  viscosa 200
Calocybe
  carnea 183, 200-201
Caloplaca 423
Calyptella
  hebe 146
Campanella
  alba 222

[Campanella] eberhardtii 222
  junghuhnii 222
Cantharellopsis 151, 154, 160, 163
  prescotii 153, 156-157, 159, 163
Cantharellus
  polycephalus 163-164
  prescotii 163-164
Capronia 380
Catillaria
  aeruginascens 424
Ceraceomyces
  sublaevis 222
Ceratiomyxa 335, 341
  arbuscula 337
  fruticulosa 337, 340
  porioides 337
Cercospora 357, 362, 459
  capparidis 359
  daviesiae 357, 360, 362
  kennediae 404
  stephanandrae 462
Ceriporia 310
  alachuana 222
  excelsa 222
  purpurea 222
  reticulata 222
  viridans 222, 298, 303, 310
  xylostromatoides 222
Ceriporiopsis 183, 310
  aneirina 54
  gilvescens 222, 298, 303, 310
  mucida 222
  portcrosensis 183
  subrufa 222
  subvermispora 177, 183-184, 200-202
Cerrena
  unicolor 222, 298, 303, 305
Chaetocalathus
  liliputianus 222
Chaetomastia 373, 375-376, 380-381
  CACTORUM 378, 381*
  equiseti 381
  hirtula 380-381
  littoralis 381
  sambuci 381
  scelesta 381
Chaetophoma 374, 377
Chaetoporellus
  latitans 222
Chromocrea
  nigricans 469
Chromosporium
  croceum 51
  fulvum 51
Cicinnobella 382
Clavaria 323-324, 326, 328, 332
  corniculata 324
  fusiformis 326
  laeticolor 329
  pulchella 331
  pulchra 329
Clavariadelphus
  pistillaris 184, 200-201
Clavulina
  cristata 156
Clavulinopsis 324, 332
  corniculata 323-324
  fusiformis 323, 326
  laeticolor 329
    f. bulbispora 330
  pulchella 331
  pulchra 329
Climacocystis 306
  borealis 298, 303, 306
Climacodon
  pulcherrimum 222
Cliostomum 421
  flavidulum 421, 424, 427
Clitocybe 152, 159, 184
  brevibasidiata 151, 163
  catinus 184, 200-201
  deceptiva 184
  fragrans 184
  gibba 184
    var. gibba 184, 200-201
  nebularis 184, 201
  obsoleta 184, 200-201
  odora 184, 201
  rosella 151, 161
Coccospora 55
  aurantiaca 55
  sinensis 52, 55
Coccotrema 429, 431-432
  CORALLINA 429, 430*-431, 434
  cucurbitula 429
  FERNANDEZIANA 429,
    431*-432, 434

[Coccotrema] MAGELLANICA 429, 431, 432*-434
  porinopsis 429, 431, 434
Collema
  multipartitum 447
Collybia
  butyracea 184, 201
Coltricia 154
  cinnamomea 222
  perennis 156, 298, 303-304, 308-309
Comatricha 335, 341
  longa 337
  pulchella 340
Coniophora
  arida 184, 200-201, 223
  elegans 70
  hanoiensis 223
  kauaiensis 223
  olivacea 223
  puteana 184, 223
  radians 200
Coniosporium
  fulvum 51
Coniothyrium 374
  parasitans 382
Conocybe
  ambigua 184
  pilosella 184, 200-201
  rickenii 185
  rubiginosa 184, 200-201
  semiglobata 185, 200
  siliginea 185, 200-201
  tenera 185
CONTUMYCES 151, 160-161*
  BRUNNEOLILACINA 162*
  ROSELLA 156, 160-161*
  VESUVIANA 162*
Coprinus
  Sect. Micacei 185
  cinereus 185, 200-201, 223
  comatus 185, 201
  curtus 223
  disseminatus 185, 201, 223
  domesticus 185
  lagopus 223
  micaceus 185, 201, 223
  radians 185, 201, 223
  silvaticus 185, 200-201
  truncorum 223
  xanthothrix 185, 200-201
Coriolopsis 320
  gallica 317, 319-320
  polygona 223
  polyzona 320
Coronicium
  thymicola 223
Corticium 289
  confusum 223
Cortinarius 190
  Subg. Phlegmacium 190
  alboviolaceus 185, 201
  amoenolens 185, 201
  cinnabarinus 185, 200-201
  pseudosalor 185, 200-201
  sanguineus 185
  trivialis 186, 200-201
Cotylidia 153-154, 158-159, 161, 164
  aurantiaca 153-154, 156
    var. alba 153, 156
  diaphana 153-154, 156
  undulata 153
Craterium 335, 341, 352
  leucocephalum 337, 348
  paraguayense 347-348, 351-352, 354-355
  rubescens 347-348, 352, 354
Crepidotus 172, 216
  alabamensis 223
  amygdalosporus 223
  appalachianensis 223
  applanatus
    var. globigera 223
  avellaneus 223
  bakerae 223
  mollis 186, 201, 223
  nephrodes 223
  roseus
    var. boninensis 223
  sphaerosporus 186, 201
  stromaticus 223
  uber 223
Cresponea 409 - 410
  follmanii 410
  proximata 409-411
Cribraria 335, 341
  argillacea 337
  intricata 337

[Cribraria] microcarpa 340
Cristella
  bispora 454
Crustoderma
  dryinum 223
  gigacystidium 223
Crustomyces
  heteromorphum 223
  subabruptus 177, 186, 200-202
Cryptoporus 305
  volvatus 298, 303-305, 317, 319
Cryptotrama
  asprata 224
Cucurbitaria 386
Cylindrobasidium
  torrendii 289, 291
Cyphella
  hebe 146
  pseudopanax 146
Cyphellopsis
  anomala 224
Cyphellostereum 161, 164
Cystidiodontia
  laminifera 289, 291
Cystostereum
  australe 224

Dacrymyces 174
  deliquescens
    var. deliquescens 224
    var. minor 224
  enatus
    var. macrospora 224
Dacryobolus
  sudans 224
Dacryopinax
  spathularia 224
Daedalea
  quercina 298, 303-306
Daedaleopsis 305
  confragosa 298, 303-305, 317, 319
  tricolor 317, 319
Datronia 305, 307, 315, 318, 320-321
  mollis 298, 303-305, 317-319
  scutellata 317-319
Deflexula
  pacifica 224
Dendrophora
  albobadia 224, 289, 291
  versiformis 224
Dendropolyporus 315, 318
Dendrothele
  candida 224
  incrustans 224
  microspora 224
  pachysterigmata 224
  strumosa 224
Dentipellis
  fragilis 177, 186, 200-201
Dentocorticium
  sulphurellum 317, 319
Diacanthodes 306
  novo-guineensis 298, 303, 306
Diachea 335, 341
  leucopodia 337
Diatrype
  disciformis 180, 201
Dichomitus 305
  squalens 298, 303, 305
Dichostereum
  pallescens 224
Dictydium 335, 341
  cancellatum 337
Dictyosporium 415
  alatum 416
  bulbosum 416
  digitatum 416
  giganticum 416, 418
  heptasporum 416, 418
  MUSAE 416*-418
  nigroapice 416
  subramanianii 416, 418
  tetraseriale 416
Diderma 335, 341
  hemisphericum 338
  spumarioides 338
  testaceum 338
Didymium 335, 341, 351
  bahiense 337-338
  clavus 338
  difforme 338
  eximium 338
  iridis 338
  melanospermum 338
  minus 338
  paraguayense 351-352
  squamulosum 338, 348
  xanthopus 338

Didymosphaeria
  atraseptata 373, 383
Digitoramispora 111
  caribensis 111
Digitothyrea
  divergens 444, 448
  polyglossa 444, 448
Dimerium 382
Diplomitoporus
  flavescens 298, 303
  lindbladii 224
  overholtsii 224
Ditiola
  radicata 224
Donkella
  corniculata 324
Donkiporia
  expansa 298, 303, 305

Earliella
  scabrosa 224, 298, 303, 305
Echinochaete
  brachyporus 298, 303-305
Echinoporia 306
  hydnophora 303, 306
  hydnoporia 298, 304
Endophragmia 95
Endophragmiella 95-98, 110-111
  cambrensis 98
  fuliginosa 96, 106
  pallescens 103
  tenera 98
  valdiviana 98
Endoptychum 186
  agaricoides 177, 186, 191, 193, 200-202
  arizonicum 186
  depressum 186
  melanosporum 186
Enteridium 335, 341
  lycoperdon 338
Entoloma
  dysthaloides 277-278
  fragilissimum 225
  hirtipes 186, 200-201
  nanosordidum 225
  purum 225
  sinuatum 186, 201
Eopyrenula 373
Ephebe
  brasiliensis 444, 448
Epithele
  hydnoides 225
  nikau 225
  sulphurea 225
Eriosphaeria
  investans 385-386
Eudarluca 375
Exidiopsis
  calcea 225
  fugacissima 225
  molybdea 225
  mucidinea 225
  plumbescens 225

Favolaschia 169, 172, 174
  Sect. Favolaschia 174
  Subsect. Auriscalpium 174
  calocera 169-170, 173-175
    var. claudopus 174
  pegleri 175
  sachalinensis 175
  thwaitesii 174
Favolus 315, 318
Fibricium
  rude 156
Fibulomyces
  mutabilis 225
Fistulina 296
Flagelloscypha 146
  pseudopanacis 146
  pseudopanax 146
Flaviporus 307
  brownii 298, 303, 307
Flavodon
  cervino-gilvus 225
  flavus 298, 303, 307-308
Fomes 305, 315, 320-321
  fomentarius 186, 201, 298, 303-305, 315, 317-320
Fomitella
  supina 298, 303, 305
Fomitopsis
  nivosa 225
  pinicola 298, 303, 305-306
Fuligo 335, 341
  septica 338, 340
Fuscocerrena 307
  portoricensis 298, 303, 307

Galerina
  atkinsoniana 225
  decipiens 225
  nana 225
  ohiarum 225
  physospora 225
  velutipes 225
Ganoderma 305, 309
  adspersum 187
  applanatum 187, 201
  australe 187, 201, 225
  carnosum 187, 200-201
  lucidum 187, 225, 298, 303, 309, 317, 319
  pfeifferi 187, 200-201
  resinaceum 187
Garnaudia 98
  elegans 98
Geastrum 187
  campestre 187
  schmidelii 177, 187, 200-202
Gerronema 151, 158, 164
  albidum 163
  brevibasidiatum 159,163
  daamsii 162
  marchantiae 152, 158, 162
  postii 158, 162
  prescotii 163
  roseopallidum 162
  strombodes 158
  subclavatum 158
Globifomes
  graveolens 298, 303-305
Gloeocystidiellum
  aspellum 289, 291
  clavuligerum 225
  lactescens 225
  leucoxanthum 177, 187, 200-202
  porosum 225
Gloeodontia
  discolor 225
Gloeophyllum 306
  sepiarium 225, 298, 303-306
  striatum 226
  trabeum 226
Gloeoporus
  dichrous 226
  thelephoroides 298, 303
Gloiocephala
  epiphylla 226
Glutinoagger 54
  fibulatus 54
Gomphus 331
  novaezelandia 156
Grammothele
  fuligo 226
Grifola 304, 310
  frondosa 187, 201, 298, 303, 310
  rosulata 226
Gymnopilus
  carbonarius 195
  subtropicus 226
Gymnopus
  luxurians 226
  subpruinosus 226
Gymnosporium
  croceum 51
  fulvum 51
Gyrodontium
  versicolor 226
Gyromitra
  gigas 180, 200-201
  infula 181, 201

Hadrospora
  fallax 381
Halosarpheia 115
  heteroguttulata 115-116, 118-119
Handkea
  utriformis 187, 200-201
Hapalopilus 310
  nidulans 298, 303, 310
Haploporus
  odorus 298, 303-305
Haplotrichum 41-43, 48, 51, 54-56, 70, 72, 74, 77, 80, 82, 90
  Subg. Fibulinum 70
  Subg. Haplotrichum 70
  Sect. Avesiculata 50, 62, 82
  Sect. Vesiculata 74, 79
  Subsect. Ellipsoidea 50, 62
  Subsect. Ramosa 74, 79
  Subsect. Sphaeroidea 82
  album 55, 66, 70, 80, 89, 91
  ARMENIACUM 44*-48, 59, 82, 86
  capitatum 41, 54, 59, 89-90
  caribense 48-49, 51, 87

[Haplotrichum] chilense 55, 80, 89
  conspersum 48, 50, 54, 62-63, 68, 84, 87, 226
  CROCEUM 51*, 53-55, 80, 87
  curtisii 41, 43, 48, 51, 56-60, 64, 66, 80, 87, 226
  dubium 54-55, 70, 88
  ellipsosporum 50, 61-63, 68, 87
  gracile 74, 87
  LAEVISPORUM 63*-66, 87
  linderi 79, 88
  magnisporum 50, 62-63, 66-68, 87
  medium 55, 68-70, 77, 80, 88
  MORGANII 70*-72, 77, 82, 86, 90
  ochraceum 89
  ovalisporium 58, 66, 80, 88
  parmastoi 73-74, 82, 89
  perseae 42, 55, 80, 86
  PONDEROSUM 75*-77, 88
  pulchrum 77, 79, 89
  PULVERACEUM 79*-81, 89-90
  ramosissimum 89
  rubiginosum 48, 51, 86
  simile 55, 66, 88
  sphaerosporum 43, 82-83, 86
  tenerum 48, 80, 82, 84-86
  tomentosum 51, 55, 60, 86
  vesiculosum 58, 88
Hebeloma
  crustuliniforme 187, 200-201
  sinapizans 187, 201
Helicobasidium
  anomalum 226
Helicogloea
  lagerheimii 226
Heliocybe
  sulcata 226
Helminthosporium
  saponariae 2
Helvella
  crispa 181, 200-201
  lacunosa 181, 201
Hemimycena
  tortuosa 226
Hemitrichia 335, 341
  calyculata 338, 340
  clavata 338
  insignis 336-338
  serpula 338
  stipitata 338
  vesparium 338
Henningsomyces
  candidus 226
  separatus 226
Heppia
  adglutinata 444, 448
  conchiloba 444, 448
  despreauxii 444, 448
Hericium
  alpestre 187
  coralloides 187, 201
  erinaceus 188, 201
Herpotrichia
  rhodospila 377
Heterobasidion
  annosum 156, 298, 303, 309
Heterochaete
  delicata 226
  gelatinosa 226
  lividofusca 226
  microspora 226
  mussooriensis 226
  ogasawarsimensis 227
  shearii 227
  verruculosa 227
Heterosporium
  echinulatum 10
Heterothecium
  diffluens 422
Hexagonia
  hydnoides 298, 303, 305
Hohenbuehelia
  approximans 227
  atrocaerulea
    var. grisea 227
Hyaloscypha
  hyalina 181, 200
  leuconica 181
Hydnellum 156
Hydnopolyporus
  fimbriatus 298, 303
Hydnum
  repandum 188, 201
Hydropus
  semimarginellus 227
Hygrocybe
  hapuuae 227

Hygrophoropsis
  albida 163
  aurantiaca 156
Hygrophorus
  cossus 188, 200-201
  eburneus 188, 201
Hymenochaete
  anomala 227
  corrugata 227
  mougeotii 227
  rhabarbarina 156
  rubiginosa 188, 201
  tomentelloidea 227
Hymenoscyphus
  virgultorum 181, 200
Hyperphyscia 437
Hyphoderma
  argillaceum 227
  budingtonii 227
  cremeoalbum 227
  crystallophorum 227
  definitum 227
  griseoflavescens 289, 291
  medioburiense 227
  naiophila 227
  nudicephalum 227
  pallidum 227
  praetermissum 188, 200-201, 227
  puberum 227
  sambuci 227
  setigerum 227
  sphaeropedunculatum 228
  subdefinitum 228, 289, 292
  subpraetermissum 289, 292
  vulcanense 228
  zeylanica 52
Hyphodermella
  maunakeaensis 228
Hyphodontia 154, 309
  aloha 228
  alutaria 154, 228
  arguta 228
  aspera 188, 200-202
  barba-jovis 188, 200-202, 289, 292
  breviseta 188, 228
  crassa 289, 292
  crustosa 228, 289, 292
  granulosa 228
  hastata 228
  microspora 228
  nespori 228
  niemelaei 289, 292
  pallidula 156, 228
  pruni 228
  radula 154, 156
  rimosissima 228
  serpentiformis 156
  spathulata 228
  subbrevipes 201
  verruculosa 228
Hypholoma
  fasciculare 201, 228
  sublateritium 188, 201
Hypochnicium
  eichleri 228
  lundellii 228
  punctulatum 228
  sphaerosporum 228
Hypocrea 463, 473
  albocornea 463-464, 473-474
  aurantia 463, 465-466, 474
  cornea 465
  muroiana 463, 467-468, 474
    f. dimorphospora 469
    f. minor 469
    f. muroiana 469
  nigricans 463, 469-470
  pachybasioides 463, 471-472, 474
Hypoxylon 382
  fragiforme 181, 201
Hypsizygus
  tessulatus 188, 201

Immotthia 373, 376, 382-383
  atrograna 378, 383
  ATROSEPTATA 383*
  hypoxylon 382
Incrustocalyptella
  hapuuae 228
  pseudopanacis 146
Inocybe
  geophylla
    var. lilacina 188, 201
Inonotus 154, 309
  hispidus 298, 303, 309
  nodulosus 156, 189, 200-202
Iocraterium 352

Irpex 308
  griseo-fuscescens 228
  lacteus 298, 303, 308
Ischnoderma 307
  resinosum 298, 303, 307

Jacobia 151, 159-160
  brunneolilacina 159, 162
  rosella 161
  vesuviana 159, 162
Jahnoporus
  hirtus 298, 303, 306
Jenmania
  goebelii 444, 448
Junewangia 95-96
Junghuhnia 307-308
  nitida 229, 298, 303, 307

Kirramyces
  hebes 145
Kramasamuha 98
  sibika 98
Kylindria 139-140
  excentrica 139

Laccaria
  amethystina 189, 201
  laccata 189, 201
    var. moelleri 189
    var. pallidifolia 189, 200-201
Lachnella
  alboviolescens 229
  conferta 229
  hebe 146
  pseudopanax 146
Lacrymaria
  lacrymabunda 189, 201
Lactarius
  blennius 189, 201
  circellatus 189, 201
  deliciosus 189, 201
  piperatus 189, 201
  vellereus 189, 201
Lactocollybia
  epia 229
Laetiporus 308
  sulfureus 189, 201, 229
  sulphureus 298, 303, 307-308, 317, 319
Laxitextum
  bicolor 289, 293
Lecanactis
  leprieurii
    f. brachyospora 410
  proximata 410
Lecanora
  melanochlora 438
  milvina
    var. subdeflectens 438
  proximata 410
Lecidea
  ceroplasta 411
  concava 423-424
  diffluens 422-423, 427
Lempholemma 448
  socotranum 447
Lentinellus
  flabelliformis 189, 201
Lentinula
  edodes 471
Lentinus 281, 286, 305, 315-316, 318, 320-321
  Subg. Lentinus 321
  bertieri 229
  ciliatus 229
  crinitus 317-319, 321
  cyathiformis 281
  lepideus 188
  tigrinus 317-319, 321
Lenzites 305
  betulina 298, 303, 305, 317, 319
Lepiota
  alba 190, 200-201
  besseyi 229
  castanea 190, 200-201
  clypeolaria 190, 200-201
  cristata 190, 201
  erminea 190
  oreadiformis 190
  ventriosospora 190, 200-201
Lepista
  flaccida 190, 201
  inversa 190
  nuda 190, 201
Leproloma
  cacuminum 438
Leptoglossum
  laeve 164
  polycephalum 163

Leptoporus 309
    mollis 298, 303-304, 308
Leptosphaeria 377-378
  circinans 377
  dichroa 377
  discors 377-378
  incarcerata 377
Leptospora 375
Leptosporomyces
  ovoideus 229
  roseus 229
Leucocortinarius
  bulbiger 177, 200-201
Leucogyrophana
  mollusca 229
  olivascens 229
Lichina 443, 447
  confinis 443-444, 447-448
  pygmaea 443-444, 447-448
Lichinella
  cribellifera 444, 448
Lignosus
  sacer 298, 303, 305
Lithographa 421
  graphidioides 426
  subantarctica 421, 426
Loculohypoxylon 376, 378, 383
  grandineum 383
Lojkania 384
  nuda 384
  utahensis 384
Lopadium
  diffluens 422
Lopharia
  mirabilis 289, 293
Lophidium
  pachystomum 386
Lophiostoma 377
LORELEIA 151, 158-160, 162*
  MARCHANTIAE 156, 158-159, 162*
  POSTII 158, 162*
  ROSEOPALLIDA 162*
Loweporus
  fusco-purpureus 298, 303, 305
Lycogala 335, 341
  epidendrum 338
Lycoperdon
  echinatum 190, 201
  foetidum 190, 201
  perlatum 190, 201
  pyriforme 190, 201
Lyophyllum
  connatum 190, 200-201

Macrohyporia
  dictyopora 298, 303
Macrolepiota
  excoriata 191, 200-201
  mastoidea 191, 200-201
  procera 191, 201
  rhacodes
    var. hortensis 191, 201
Macrosporium 1, 10
  congestum 13-14
  dianthemphus 14
  dianthi 7, 15
  erectum 100
  melandrii 31
  nobile 7, 16, 29
  saponariae 2, 29
  seguierii 11-12
  trisectum 24-25
  truncatum 12-13
  vaccariae 20-21
  verruculosum 18
Malbranchea 80
  pulveracea 79
Marasmiellus
  pacificus 229
  palmivorus 229
  rosellus 161
Marasmius 172
  alliaceus 191, 201
  pseudobambusinus
    var. hawaiiensis 229
  radiatus 229
  wynnei 191, 200-201
Massarina 376
Massariosphaeria 375, 380
Megasporoporia
  cavernulosa 229, 298, 303, 305
  hexagonoides 317, 319
Melanoleuca 191
  Subsect. Grammopodinae 192
  brevipes 191, 200-201
  evenosa 191, 200-201
  favrei 192

[Melanoleuca humilis]
    var. blanda 191, 200-201
  iris 192, 200-201
  melaleuca 200
  pseudoevenosa 191-192, 200-201
  subalpina 191
  subbrevipes 192, 200
  substrictipes 192
Melanomma
  nigricans 377
Melanoporella 307-308
  carbonaceus 298, 303, 308
Melanoporia 307-309
  nigra 298, 303, 307
Melanopsammina
  utahensis 373, 384
Melanopus 315
Melogramma
  effusum 377
Meripilus 304, 310
  giganteus 187, 192, 200-201, 298,
    303-304
Meruliopsis
  corium 229
Merulius 296
  tremellosus 192, 201
Metamelanea 447
  melambola 444
Metasphaeria
  rubida 377
Metatrichia 335, 341, 343
  vesparium 338
Microporellus
  dealbatus 298, 303, 306
Microporus
  flabelliformis 229
  vernicipes 317, 319
  xanthopus 298, 303, 305
Miltidea 409
  ceroplasta 409, 411-412
Monilia
  candicans 91
  pulveracea 79
Montagnula 380
Morchella
  elata 181, 200-201
Moristroma 376, 383
  polyspora 378, 383
Mucor
  croceus 51
Mucronella
  aggregata 229
Multiclavula 153
Munkovalsaria 375
Mycena 172, 192
  adscendens 229
  alphitophora 229
  arcangeliana 192, 201
  capillaris 192, 200-201
  crocata 192, 201
  discogena 229
  flavescens 192, 200-201
  galericulata 192-193, 201
  haematopus 193, 200-201
  hawaiiensis 230
  inclinata 193, 200-201
  niveipes 193, 200-201
  oortiana 192
  papyracea 230
  polyadelpha 192
  polygramma 183, 200-201
  pura 183, 201
  rosea 193, 201
  sotae 230
  spinosissima 230
  stylobates 193, 200-201
Mycenastrum
  corium 177, 193, 200-202
Mycoacia
  aurea 230
  kurilensis 230
Mycosphaerella 357-358, 363, 397,
  400, 402, 405-406
  daviesiae 363-364
  DAVIESICOLA 357, 363-364*
Mystrosporium 97
  erectum 99

Nectria 124
  cinnabarina 121-122, 124-125
Nematogonium
  album 91
Neocallimastix 410
  frontalis 410
Neolentinus 281, 286
  schaefferi 281-285
Neoramularia
  capparidis 359

Nigrofomes 307-309
  melanoporus 298, 303-304, 307
Nigrohydnum 307
Nigroporus 307
  vinosus 230, 298, 303-304, 307
Nitschkia 121, 124-125
  brevispina 121
  cupularis 121
  fuckelii 123, 125
  grevillei 121
  molnarii 124
  moravica 123, 125
  parasitans 121, 124-125
    var. MIJUSKOVICII 121-123*, 124-125
Nodulisporium
  album 91
Nyctalis 72

Ohleria 375
Oidium 41-42, 46, 48, 54, 58-59, 74, 80, 91
  album 91
  armeniacum 46, 48
  aureo-fulvum 55
  aureum 42, 54, 70
  bloxamii 91
  candicans 59, 91
  capitatum 91
  caribense 48
  curtisii 58-59, 64, 66
  effusum 44, 46, 48
  ellipsosporum 62
  laevisporum 58, 63-64, 66
  magnisporum 66
  medium 68
  morganii 70
  pulchrum 77-78
  pulveraceum 55, 79
  rubiginosum 51
  simile 42, 52, 55
  sphaerosporum 82
  tenerum 84
Oligoporus 183, 199, 306
  balsameus 230
  caesius 193, 230
  floriformis 230
  fragilis 230
  hibernicus 193, 200-201
  perdelicatus 230
  placentus 230
  rennyii 298, 303
  simani 193, 202
  stipticus 194, 230
  subcaesius 193, 200-202
  tephroleucus 194, 200-202
  undosus 230
Omphalia
  cincta 163
  rosella 161
Omphalina 151-152, 156-158
  brevibasidiata 152, 157, 159, 163
  marchantiae 157-158
  postii 158
  pyxidata 156-158
  rosella 152-153, 157, 159, 161
  vesuviana 162
Omphalotus
  olivacens 156
Onnia 309
Orpinomyces 410
Oudemansiella 269, 273-275
  Subg. Oudemansiella 274
  Sect. Oudemansiella 274
  australis 274
  canarii 274-275
  ephippium 194, 200-201
  FIBRILLOSA 269, 270*-275
  longipes 199
  mucida 194, 201
  platensis 275
  yunnanensis 274
Oxyporus 154, 310
  corticola 177, 187, 194, 200-202, 230
  latemarginatus 194, 230, 310
  populinus 156, 298, 303, 310
  similis 230

Pachybasium 471-472
Pachykytospora
  tuberculosa 298, 303, 305
Panaeolus
  acuminatus 194
  caliginosus 194
  rickenii 194, 200, 202
Panellus
  stypticus 194, 202

Panus 286, 316, 318
Parahaplotrichum
  idahoense 44, 86, 88
Parmastomyces
  transmutans 230, 298, 303
Parvobasidium
  cretatum 230
Passalora
  indica 357
Passariniella 377-378
  dichroa 377-378
  incarcerata 377
Patellaria
  aeruginascens 424, 427
Paulia 443, 446-447
  aldabrensis 444, 448
  caespitosa 444, 448
  gibbosa 444, 447
  myriocarpa 444, 447
  perforata 444, 447-448
  schroederi 447
Paullicorticium
  niveocremeum 156
Paxillus
  curtisii 230
  panuoides 230
Peccania
  arizonica 444, 448
  coralloides 444, 448
  fontqueriana 444, 448
Pellicularia
  pruinata 59
  vaga 59
Peltula 447
  obscurans 448
    var. hassei 444
  radicata 444, 448
Peniophora
  cinerea 230
  crustosa 230
  incarnata 194, 202, 230, 289, 293
  lycii 230
  nuda 230
  pithya 231
  scintillans 231
Perenniporia 306
  japonica 231
  medulla-panis 298, 303-305
  subacida 231
  tephropora 231
Perichaena 335, 341, 343
  chrysosperma 338, 341
  chrysospora 338
  depressa 338, 341
  microspora 338
Periconia 137
Pertusaria
  colobina 432
Pestalopezia
  rhododendri 383
Peziza 181
  avernensis 181, 201
  cerea 181
  micropus 181, 202
  moravecii 181, 200, 202
Phacellium 459, 462
  sessile 459, 462
  STEPHANANDRICOLA 459*, 461
Phaeolus 296, 308
  schweinitzii 46, 231, 298, 303-304, 308-309
Phaeophleospora 145
  ATKINSONII 145*
  hebes 145
Phaeosphaeria 378, 381
  celata 381
Phallus
  impudicus 194, 202
Phanaerochaete 154, 310
  aculeata 231
  arizonica 231
  australis 231
  avellanea 231
  chrysorhiza 156, 231
  crescentispora 231
  eburnea 231
  hiulca 231
  jose-ferreirae 231
  magnoliae 231
  mauiensis 231
  sordida 194, 200, 202, 231
  suballantoidea 231
  tuberculata 194, 200, 202
Phellinus 154
  contiguus 231
  fastuosus 231
  ferruginosus 231

[Phellinus] gilvus 231, 234, 298, 303, 309
  grenadensis 231
  igniarius 298, 303, 307, 309
  kawakamii 231
  melleoporus 231
  robustus 231
  rufitinctus 232
  viticola 156
  wahlbergii 232
Phialoocephala 137
  ivoriensis 139
  VITTALENSIS 133, 136-137*, 139
Phlebia 154, 310
  acanthocystis 232
  acerina 232
  coccineofulva 232
  hydnoidea 232
  lilascens 232
  livida 195, 200, 202, 232
  radiata 156
  rufa 195, 202
  subfascicularis 232
  tremellosa 232
  tristis 154
Phlebiella
  fibrillosa 232
  subflavidogrisea 232
  tulasnelloidea 232
Phlebiopsis
  flavido-alba 232
  peniophoroides 232
  ravenelii 232
Phloeopeccania
  pulvinulina 444, 448
Pholiota 195
  alnicola 195, 200, 202
  cerifera 195, 201
  curvipes 195
  highlandensis 195, 200, 202
  peleae 232
  tuberculosa 195, 200, 202
Phomopsis
  peperomiae 371
Phragmocephala 97-98
Phylliscidium
  monophyllum 444
Phyllisciella 447
Phylliscum 447
  demangeonii 444
Physalacria 174
Physarella 335, 341
  oblonga 339
Physarum 335, 341
  bethelii 339
  bivalve 339
  bogoriense 339
  cinereum 339
  compactum 339
  compressum 339, 341
  didermoides 339
  flavicomum 339
  gyrosum 339
  javanicum 339
  melleum 339
  newtonii 347-350, 354-355
  nutans 339, 341
  pezizoideum 339
  polycephalum 335, 339, 341
  pusillum 339
  sinuosum 339
  stellatum 339
  tenerum 339
  vernum 339
  virescens 339
  viride 339
Physisporinus
  sanguinolentus 195, 232
  vitreus 177, 195, 200, 202, 232, 298, 303
Physospora
  albida 91
  elegans 70
Phytophthora 392
  cinnamomi 391-392
    var. cinnamomi 392
    var. parvispora 392
    var. ROBINIAE 391, 392*-394
  drechsleri 391
  nicotianae 391
  richardiae 391-392
  robinicola 391-392
Piloderma
  byssinum
    var. byssinum 232
Piloporia 307
  sajanensis 298, 303-304, 307
Piptoporus 305
  betulinus 298, 303-304

Piricauda
  serendipita 100, 102
Pleospora 18
  obiones 373, 378
  savoryellopsis 378
Pleuroflammula
  flammea 232
Pleurotus 281, 286, 316, 318
  cystidiosus 233
  djamor 233
  dryinus 195, 200, 202
  ostreatus 195, 201-202, 233
  pulmonarius 195, 200-201
  salignus 202
Pluteus
  diettrichii 195
  nanus 195, 200, 202
  petasatus 196, 200, 202
  salicinus 196, 200, 202
Podofomes
  trogii 298, 303, 305
Podoscypha 153-154
  parvula 153, 156
Polyporellus 315, 318
Polyporoletus
  sublividus 298, 303, 308-309
Polyporus 196, 305, 310, 315-316, 318-321
  alveolaris 317-320
  arcularius 196, 201, 233, 315, 317-321
  badius 196, 200, 202
  melanopus 196, 200, 202, 317-319
  schulzeri 198
  schweinitzii 46
  squamosus 156, 298, 303-305, 317-320
  tricholoma 233
  tuberaster 317-319
  umbellatus 317-319
  varius 196, 201, 317-319
Porodisculus
  pendulus 298, 303
Porostereum
  spadiceum 289, 293
Porotheleum 296
Porpidia
  tuberculosa 421, 427
Pouzarella 269, 277-278
  Sect. Dysthales 277
  Subsect. Dysthales 277
  CARIBAEA 269, 276*-278
  dysthales 277-278
Psathyrella
  candolleana 196, 201
  conopilus 196, 200, 202
  fuscofolia 233
  hydrophila 233
  murcida 196, 200, 202
  pannucioides 196, 200, 202
  singeri 233
  tephrophylla 197, 200, 202
Pseudocercospora 397, 405-406, 462
  HOPETOUNENSIS 397, 402*-403, 405-406
  kennediae 397, 399-400, 403-406
  KENNEDIICOLA 397*, 399-400, 405-406
  stephanandrae 459, 462
  WARCUPII 397, 400*-402, 405-406
Pseudocercosporella 405
Pseudoclitocybe
  cyathiformis 197, 201
PSEUDOPAULIA 443, 446*-447
  TESSELLATA 443-444, 446*-448
Pseudopiptoporus 306
  devians 298, 303-304, 306
Pseudotomentella
  ochracea 156
Psorotichia 447
  diffracta 444
  murorum 444, 448
  polyspora 444, 448
  schaereri 444, 448
Pterygellus 163-164
  polycephalus 163-164
Pterygiopsis 447-448
  guyanensis 444, 448
  submersa 444
Ptychogaster 72
Pulccherricium
  caeruleum 200, 202
Pulveroboletus
  xylophilus 233
Pycnoporellus 308-309
  fulgens 298, 303, 308
Pycnoporus 305
  cinnabarinus 233, 298, 303, 305, 317, 319

[Pycnoporus] sanguineus 233
Pyrenochaeta 374
Pyrenopsis 444, 448
Pyrofomes 306
  demidoffii 298, 303-304, 306
Pyrrhoglossum
  pyrrhum 233
Pyrrhospora 423

Radulomyces
  kama'aina 233
  poni 233
Ramaria 197, 331
  Subg. Lentoramaria 326
  aurea 197, 202
  corniculata 324, 326
  eumorpha 156
  flava 197, 202
  flavescens 197, 200, 202
Ramariopsis 323-324, 331-332
  corniculata 323-325, 327, 332
  fusiformis 323, 325-329
  kunzei 323
  laeticolor 323, 325, 327, 329-330
    f. bulbispora 323, 327, 329-330
  pulchella 323, 325, 327, 331
Ramboldia 421, 423
  petraeoides 423
    var. CONCAVA 421, 423*-425
    var. petraeoides 424-425
Resinicium 154
  bicolor 154, 156, 158, 233
  saccharicola 233
Resupinatus
  applicatus 233
  striatulus 233
RHEXOACRODICTYS 95, 98*-99, 110-112
  ERECTA 99*, 101-103, 106, 110-111
  FIMICOLA 103*-107, 110-111
  FULIGINOSA 106*, 109-111
  QUEENSLANDICA 110*-111
Rhinotrichum 43, 64
  armeniacum 44-46
  bloxamii 91
  curtisii 43
  fulvum 51
  laevisporum 63
  mexicanum 42-43
  niveum 91
  pulchrum 77
  pulveraceum 79
  subalutaceum 43
  subferruginosum 43
  tenerum 84
Rhizocarpon 424
  diffluens 422
  obscuratum 427
  reductum 427
Rhodocollybia
  laulaha 233
Rickenella 151-154, 158-160, 164
  brunneolilacina 162
  mellea 152-153, 156-157
  pseudogrisella 152-153, 156-157
Rigidoporiopsis 309
  amylospora 298, 303, 307
Rigidoporus 309-310
  lineatus 233
  microporus 233, 298, 303-304, 307
  ulmarius 233
  undatus 233
  vinctus 234
Rinodina 437, 440
  balanina 439
  cacuminum 437-438, 440
  milvina 439
    var. melanochlora 437-438
    var. subdeflectens 438
  pyrina 439
  sophodes
    var. milvina 438
    f. cacuminum 438
Russula 243
  Sect. Russula 246
  Sect. Xerampelinae 241-242, 245-248, 252
  Stirp Atropurpurea 197
  abietum 251, 255
  alutacea 245-246
    f. erythropoda 245
  amoenipes 241, 248, 251-254, 260
  amoenoides 248
    var. gracilipes 249
  atrosanguinea 241, 246, 251-252, 259
  brevis 249
  brevissima 251-252

[Russula] cicatricata 249
  clavipes 247-248, 252
  cyanoxantha 197, 202
    var. cyanoxantha 200-201
    f. cyanoxantha 197
    f. peltereaui 197, 202
  delica 197, 202
  duportii 248
    f. spinulosospora 249
  elephantina 255
  emetica 243
  erythropoda 241-243, 245-246, 248-249, 251-252, 258-259, 262
  erythropus 246
  faginea 248, 251
  favrei 241-243, 246-247, 249-252, 255-256, 258
  fuscoochracea 247, 251-252, 255
  gilvescens 249
  graveolens 242, 247-248
    var. pseudomelliolens 249
    var. subrubens 247-248
    f. rubra 248
  integra 243
  linnaei 245-246, 259
  mairei 156
  marthae 252
  pruinosa 248
  pseudomelliolens 249
  purpurea 247, 259
    var. subamoenipes 249
  purpurissata 249
  quercetorum 248
  rivulosa 251-252
  rubida 249
  schaefferi 249
  suberythropus 251-252
  subpurpurea 251-252
  subrubens 247
  undulata 197, 200, 202
  vesca 245
  xerampelina 202, 241-245, 247-249, 251-252, 258-261
    var. abietum 251
    var. amoenipes 243, 253
    var. elaeodes 259
    var. erythropoda 247, 259-260
    var. erythropus 260-261
    var. fusca 246, 259
    var. linnaei 246, 260
    var. olivascens 255
    var. pseudomelliolens 259
    var. putorina 246, 255, 259
    var. quercetorum 247
    var. rubra 246, 260
    var. TENUICARNOSA 241, 153, 263*-264
    var. xerampelina 241, 153, 261

Schismatomma 421
  graphidioides 421, 426
Schizophyllum
  commune 197, 202, 234
Schizopora 154, 3090310
  flavipora 234
  paradoxa 156, 197, 201, 234, 298, 303, 309
  radula 234
Scleroderma
  citrinum 197, 200, 202
Scoleciasis
  atkinsonii 145
Scopuloides
  rimosa 234
Scutellinia
  scutellata 181, 202
Scytinopogon 332
Scytinostroma
  aluta 198
  duriusculum 234
  galactinum 234
  hemidichophyticum 234
  ochroleucum 234
  portentosum 197, 200, 202, 234
Sebacina
  epigaea 234
  incrustans 234
  opalea 234
  podlachica 234
Secotium 186
Septoria
  exotica 145
Serpula 296
  himantioides 234
  incrassata 234
Sinodidymella 373, 376, 383-384
  AMERICANA 373, 378, 384*
  HESPERIA 373, 378, 384-385*

[Sinodidymella] occidentalis 384
  UTAHENSIS 384*
  verrucosa 383-384
Sirisporium 358
Sirobasidium
  sandwicense 234
Sistotrema
  brinkmannii 156, 234
  subtrigonospermum 234
Sistotremastrum
  niveocremeum 235
Skeletocutis 307
  amorpha 298, 303-304, 307
  lenis 235
  lilacina 235
Sparassis 308
Speiropsis 129
  aquatica 129, 131
  belauensis 129, 131
  hyalospora 129, 131
  irregularis 129
  ixorae 129, 131
  pedatospora 129, 131
  ROGERGOOSENSIS 127*-131
  scopiformis 129, 131
  simplex 129, 131
Sphaeria
  atrograna 383
  incarcerata 377
  insidens 383
  parasitans 125
  rhodospila 377
Sphaerobasidioscypha 146
  citrispora 146
Sphaerobasidium
  minutum 156
SPHAGNOMPHALIA 151, 159-160, 162*
  BREVIBASIDIATA 156, 159, 163*
Spilonema
  tuberculosa 427
Spongipellis 306
  delectans 198, 200, 202
  spumeus 298, 303, 306
Sporidesmium 95
  fuscum 451
  SUBFUSCUM 451*
Sporisorium
  ranunculi 148
Sporocephalium
  capitatum 91
Sporoschisma
  saccardoi 102
Sporothrix 188
Sporotrichum 54
  aureum 54
Steccherinum 307
  ochraceum 235
  rawakense 235
Stemonitis 335, 341
  axifera 339
  ferruginea 339
  fusca 339, 341
  splendens 340
Stemphylium 1, 12-13, 18, 25
  Subg. Eustemphylium 13-14
  Subg. Pseudostemphylium 13-14
  botryosum 14
  bresadolae 13-14
  botryosum 13
  BUBAKII 1, 18*-19
  congestum 13
  herbarum 13
  lycopersici 25
  majusculum 18
  TRISECTUM 1, 25*
  vesicarium 18
Stenella 358, 405
  capparidicola 359
  capparidiicola 359
  capparidis 359
Stenocephalopsis
  subalutaceum 43
Stereum
  hirsutum 198, 201, 235
  illudens 235
  ochraceoflavum 198, 200, 202
  ostrea 235
  rugosum 198, 200, 202
  sanguinolentum 235
  subtomentosum 198, 200, 202
Stigmatidium
  graphidioides 421, 426-427
Stratiphoromyces 139-140
  brunneisporus 140
  RAGHUKUMARENSIS 133, 138, 139*-140
Stromatella 447-448
  bermudana 444, 447-448

Stropharia 198
  aeruginosa 198, 202
  caerulea 198, 200, 202
  coronilla 198, 200, 202
  rugosoannulata 156
  semiglobata 198, 200, 202
  squamosa 198, 201
    var. thrausta 200, 202
  thrausta 198
  variicolor 235
Stuartella 382
Subulicium 156
Subulicystidium
  cochleum 235
  longisporum 156, 235
Suillus
  luteus 156

Tandonella 462
Teichospora 374, 376, 383, 386
  borealis 386
  clavispora 386
  hesperia 386
  lonicerae 386
  obducens 386
  solitaria 386
  trabicola 378, 386
  winteriana 386
TEICHOSPORACEAE 373, 374*, 376
Terana
  caerulea 198
Tetrapyrgos
  nigripes 235
Thelephora 156
  terrestris 235
Thyrea
  confusa 444, 448
  pachyphylla 444, 448
Tinctoporellus
  epimiltinus 235, 298, 303
Tomentella
  chlorina 235
Trametes 305, 309-310, 318, 320-321
  cervina 235
  gibbosa 199, 202
  hirsuta 199, 202, 235
  trogii 317, 319-320
  versicolor 187, 199, 201, 235, 298, 303,
    305, 317, 319-320
Trechispora 454
  alnicola 235
  ANTIPUS 453*, 455-458
  bispora 453-454, 458
  byssinella 235
  clanculare 236
  farinacea 236
  lunata 236
  microspora 236
  mollusca 236
  stellulata 236
Trematosphaeria
  cactorum 373, 381, 386
  circinans 377
Tremella
  boraborensis 236
  foliacea 236
  fuciformis 236
  mesenterica 236
Trichamphora
  pezizoidea 339
Trichaptum 154, 296, 307, 309
  abietinum 154, 156
  perrottetii 298, 303, 307
Trichia 335, 341, 343
  favoginea 340
  persimilis 340
Trichocladium 115-116, 118-119
  constrictum 115, 119-120
  lignincola 119-120
  opacum 104
Trichoderma 465-470
  harzianum 469
Tricholoma 190, 202
  columbetta 202
  flavovirens 202
  sejunctum 202
  squarrulosum 202
  sulphureum 202
Tricholomopsis
  rutilans 236
Tubercularia 181
  vulgaris 121
Tubifera 335, 341
  microsperma 340-341
  stipitata 340
Tubulicium
  dussii 236
  raphidosporum 289, 293-294

[Tubulicium] vermiculare 156
  vermiferum 236, 289, 294
Tubulicrinis
  accedens 236
  calothrix 236
  gracillimus 236
  subulatus 156, 236
Tulasnella
  calospora 236
  pinicola 236
Tyromyces 72, 199, 306
  chioneus 177, 199-200, 202, 298, 303-304, 306
  subgiganteus 236

Ugola 72
Ulocladium 12, 14, 18
Urocystis
  antipolitana 150
  delphinii 150
  irregularis 150
  japonica 150
  pulsatillae 150
  QINGHAIENSIS 147-148*, 150
  ranunculi 147-148, 150
  sorosporioides 150

Vararia
  gomezii 236
  microhyphidia 236
Verrucaria 423
Verrucispora 357, 362
  proteacearum 357
Verrucisporota 357-358, 360, 362, 364
  brideliae 357, 362
  DAVIESIAE 357-358, 360*, 362-364
  indica 362
  KIMBERLEYANA 357, 358*-360, 362
  proteacearum 358, 360, 362
Verticillium 464-465, 469
Vesiculomyces
  epitheloides 236
Virgatospora 141
  echinofibrosa 141
  NATARAJANENSIS 133, 140, 141*
Volvariella
  bombycina
    var. ciliatomarginata 236
  volvacea 237

Wolfiporia 308
  cocos 298, 303, 307-308
Wrightoporia
  avellanea 298, 303

Xenasma
  rimicola 237
Xerocomus
  chrysenteron 199, 201
  truncatus 199-200, 202
Xerotus
  mauiensis 216
Xerula 274
  melanotricha 199
  pudens 199, 202
  radicata 199, 201-202
  xeruloides 177, 199-200, 202
Xylaria
  curta 215
  hypoxylon 181, 201

Zygodesmus 72
  effusus 44, 46-48
  laevisporus 58, 63

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[Contents continued from inside of front cover]

Book reviews and notices **David L. Hawksworth** 475
Instructions to authors: important changes and updates 489
News: Mycologia online site is launched **Jim Ginns** 491
Nomenclatural novelties proposed in volume 82 493
Author index 495
Index to fungous and lichen taxa 499
Reviewers 521
Publication date for volume 81 521